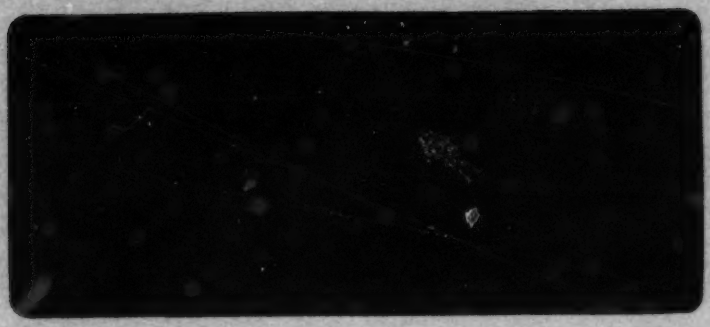
IDENTIFICATION AND SUBSTANTIATION OF CARIBOU CALVING GROUNDS ON THE NWT MAINLAND AND ISLANDS

Northwest Territories Resources, Wildlife & Economic Development



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A. GUNN
and
B. FOURNIER

DEPARTMENT OF RESOURCES, WILDLIFE AND ECONOMIC DEVELOPMENT

GOVERNMENT OF THE NORTHWEST TERRITORIES
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ABSTRACT

As background to manage human activities on caribou calving grounds, we have compiled published and unpublished information on the location of caribou calving grounds. We compiled information for 20 geographic areas where caribou calving had been recorded or inferred for at least 1 year. We excluded the major barren-ground caribou herds (Bluenose, Bathurst, Beverly and Qamanirjuaq) or caribou on Banks Island as these have been reported elsewhere, or the caribou on Baffin Island as the information was not available to us. Two sources of uncertainty hampered identifying and substantiating calving grounds. Firstly, sampling frequency (the number of surveys and years of radio-tracking available to identify calving areas) and duration of the sampled period varied widely. On average for each of the 20 calving areas, we had 4 years of information over a period averaging 11 years duration. Secondly, the amount of detail in the reports was uneven and some reports were unavailable. We defined 14 of those 20 areas as calving grounds where we had information to indicate that cows had annually returned to the area (2 year's of information with geographic overlap in calving distribution). We also recorded landscape information (terrain, elevation, vegetation) for the 20 identified calving grounds and areas. Our compilation leads us to two generalizations: firstly, our current knowledge is hedged with uncertainties and secondly, calving grounds in the Northwest Territories are diverse in their landscapes, vegetation and climate.

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INTRODUCTION

Developing a balanced approach to managing caribou calving grounds and human activities in the Northwest Territories requires extensive consultation because some of the Northwest Territories' large mineral reserves are also on caribou traditional calving grounds. Annual calving grounds overlap from year to year and the cumulative area used for calving is called the "traditional calving grounds". The annual return of caribou cows to a traditional calving ground is the most obvious characteristic of the area rather than any one feature of landscape or vegetation. The reason for caribou's use of traditional calving grounds is uncertain but their traditions have held for hundreds of years.

In November 1995, the Nunavut Wildlife Management Board and the then Department of Renewable Resources (now Resources, Wildlife and Economic Development, RWED) held a workshop on managing calving grounds in Nunavut. Workshop participants recommended that an information package be prepared and distributed and that consultations with all stakeholders begin. The Department circulated a Discussion Paper and also began to compile information to ensure that as much information as possible was available to the stakeholders.

Most surveys in the 1940s to the 1960s to estimate barren-ground caribou numbers were of late winter and spring migration ranges on the mainland. Although calving grounds were known, they were not routinely surveyed to estimate population size until tagging and field observations revealed the fidelity of cows to traditional calving grounds (Thomas 1969). Parker (1972) took the lead in estimating caribou numbers from surveying calving grounds in the late 1960s for the Qamanirjuaq herd. The advantages (Parker 1972) of surveying

barren-ground caribou on calving grounds were the greater predictability of finding calving grounds and their relatively small size. By the mid-1970s, survey techniques for calving grounds of the large barren-ground caribou herds were relatively well-established and the only subsequent major change was the addition of aerial photography (Heard 1985).

Most of the information that exists on calving distribution is, then, for the larger herds of barren-ground caribou. The reliance on surveying calving grounds to estimate trend in herd size provides three decades of calving distribution that has been summarized and reported for the Bathurst herd along with flight lines, densities and calving dates (Sutherland and Gunn 1996) and the Beverly herd (Gunn and Sutherland 1997). Wakelyn (unpublished) has mapped, in SPANS[1] software, calving distribution for the Qamanirjuaq herd and Nagy (unpublished) has mapped, in SPANS software, the cumulative distribution of 10 years of calving for the Bluenose herd.

After RWED compiled and distributed the information for the larger herds, the next step in assembling information as a basis for managing caribou calving grounds has been to pull together what is known about the smaller barren-ground herds, arctic-island caribou and Peary caribou. The smaller herds of barren-ground caribou that use the northeast mainland have received considerably less attention than the four major herds. Surveys have been irregular, infrequent and have covered geographic areas to determine seasonal distribution and relative abundance, as the seasonal ranges of the individual herds were largely unknown.

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[1] Spatial analysis software produced by TYDAC research Inc., Nepean, ON, Canada.

In the mid-1970s, as part of the environmental assessment for a proposed natural gas pipeline, extensive aerial surveys across the arctic islands and northeastern mainland mapped pre-calving and calving distribution for a number of herds whose identity at that time was relatively unknown. Subsequent surveys were infrequent and were less extensive. During the 1980s, on the central region of the northeast mainland, hunters reported increased numbers of caribou. As the herd designation of the caribou was uncertain, cows were fitted with conventional or satellite collars and tracked to their calving grounds. The tracking and associated surveys were designed to locate calving distributions but the objectives did not include mapping calving ground boundaries.

We are also less certain about the characteristics that distinguish the calving grounds of arctic-island and Peary caribou. These cows also appear to return to traditional sites or areas to calve. The herds are smaller and the lower numbers mean that the calving grounds are not as dramatically obvious as those for the larger herds where tens of thousands of cows congregate. Their calving grounds were also located by recording locations of calving caribou during reconnaissance surveys, or surveys of other wildlife conducted during the calving and post-calving periods. Conventional and satellite tracking has contributed to locating but not delimiting boundaries for calving grounds.

This report compiles published and unpublished information on calving distribution of the smaller barren-ground caribou herds on the mainland, and arctic-island and Peary caribou. We have not included Banks Island as Nagy (unpublished information) has already mapped cumulative calving and post-calving ranges. We have also not included Baffin Island as the information from surveys, satellite collars and traditional knowledge for calving grounds was unavailable at the time of this report. We have compiled information on pre-

calving and post-calving caribou and calving dates as we recognize that such information will be useful as background to managing human activities on caribou calving grounds.

METHODS

We searched published and unpublished reports from the RWED library and wildlife files to retrieve information on caribou aerial surveys and telemetry projects for May to July. We have included local knowledge when it was in the cited reports but that use is inconsistent between areas and we recognize that it is but a fraction of the local knowledge that could be compiled.

We redrew maps with flight lines and caribou sightings when they were included in the original reports because it is important to distinguish between an absence of caribou in an area that has been surveyed and an area not covered by a survey. When the report did not have a figure showing flight lines or caribou observations, we used the original survey maps when they could be found. For pre- and post-calving surveys, flight lines may or may not have been included in our figures depending on their quality in the original report. However, all reports were cited. We drew the maps in Presentations (Novell PerfectOffice) because we wanted report quality figures and our objective was to compile the data - a necessary step before any geographic-referenced analysis.

We divided the May to July information into three biological periods. We used sightings of calves in June to divide reports into pre-calving and calving. Surveys that recorded sightings of cows with calves were assigned to the calving period, although there were observations of cows with calves reported in some post-calving surveys as well. We also tabled dates when calving was first seen during a survey.

Our division between calving and post-calving is more arbitrary as calving is variable between areas and years in its onset and duration, especially at higher latitudes. We designated surveys in late June (after 25 June) and in July as

post-calving although we recognize that it is a convenient date rather than an ecological one. We also designated surveys as post-calving if the report indicated calving had finished two to three weeks previously and the caribou were leaving the calving ground.

In the text describing each survey, we have included the rationale for the survey, the dates and some details of results. Several surveys cover more than one herd's range but we have repeated some of the details of the survey for each herd. Square brackets [ ] identify any explanatory comments that we have made on reported information but we have tried to minimize our interpretations and comments.

To produce composite maps of available calving distribution we divided the calving information into three categories as follows:

1. If the June distribution of caribou was identified as cows and calves, and the distribution was within the area covered by systematic flight lines, then we displayed the distribution as a delineated calving ground. If part (roughly a quarter) of the calving distribution was not covered by systematic flights, we mapped that with a dashed line to indicate the delineation was incomplete.

2. If the report included a calving ground map without giving the details on delineation, we included the map and identified it as not having the original information for its delineation.

3. Cow-calf sightings during unsystematic flights (such as ferry or radio-tracking flights) and radio-collared cow locations during calving were mapped as either point locations or combined locations and displayed separately as calving

sightings (i.e. not delineated).

To further describe the diversity of the calving grounds and calving areas, we overlaid them on a 1:6 x 10^6 scale United States Geological Survey (USGS) map which used vegetation cover estimated from satellite (NDVA) data.

RESULTS

We compiled information for 20 geographic areas where caribou calving had been recorded or inferred for at least one year (Figure 1). Information on the calving areas of the major barren-ground caribou herds (Bluenose, Bathurst, Beverly and Qamanirjuaq) and Banks Island caribou were not included, as these have been reported elsewhere. Baffin Island caribou was not included, as the information was not available to us.

Two sources of uncertainty hampered identifying and substantiating calving grounds. Firstly, the number of surveys and years of radio-tracking available to identify calving areas varied widely in sampling frequency and duration of the sampled period (Appendix A). On average, for each of the 20 calving areas we had four years of information (Standard Error 1 year, range 0-8 years) and the information sampled a period averaging 11 years duration for each calving area (Standard Error 2 years, range 1-34 years). Secondly, the lack of detail and the unavailability of some reports added to the uncertainty in describing calving grounds. This is not necessarily a criticism of reports as they were not always designed to describe calving distribution but survey maps showing flight lines and cow-calf distribution were frequently missing.

We defined 14 of the 20 areas as calving grounds where we had information to indicate that cows had annually returned to the area (2 years of information with geographic overlap in calving distribution). For the 14 calving grounds, from 2 to 7 years of information was available with an average of 5 years $\pm$ 0.4 years (Standard Error). The designation of Simpson Lake, Keith Bay and Boothia Peninsula east as calving grounds was based on 2 years of information - the minimum for defining a calving ground. The boundaries were delineated only once for four calving grounds and twice for five calving grounds.

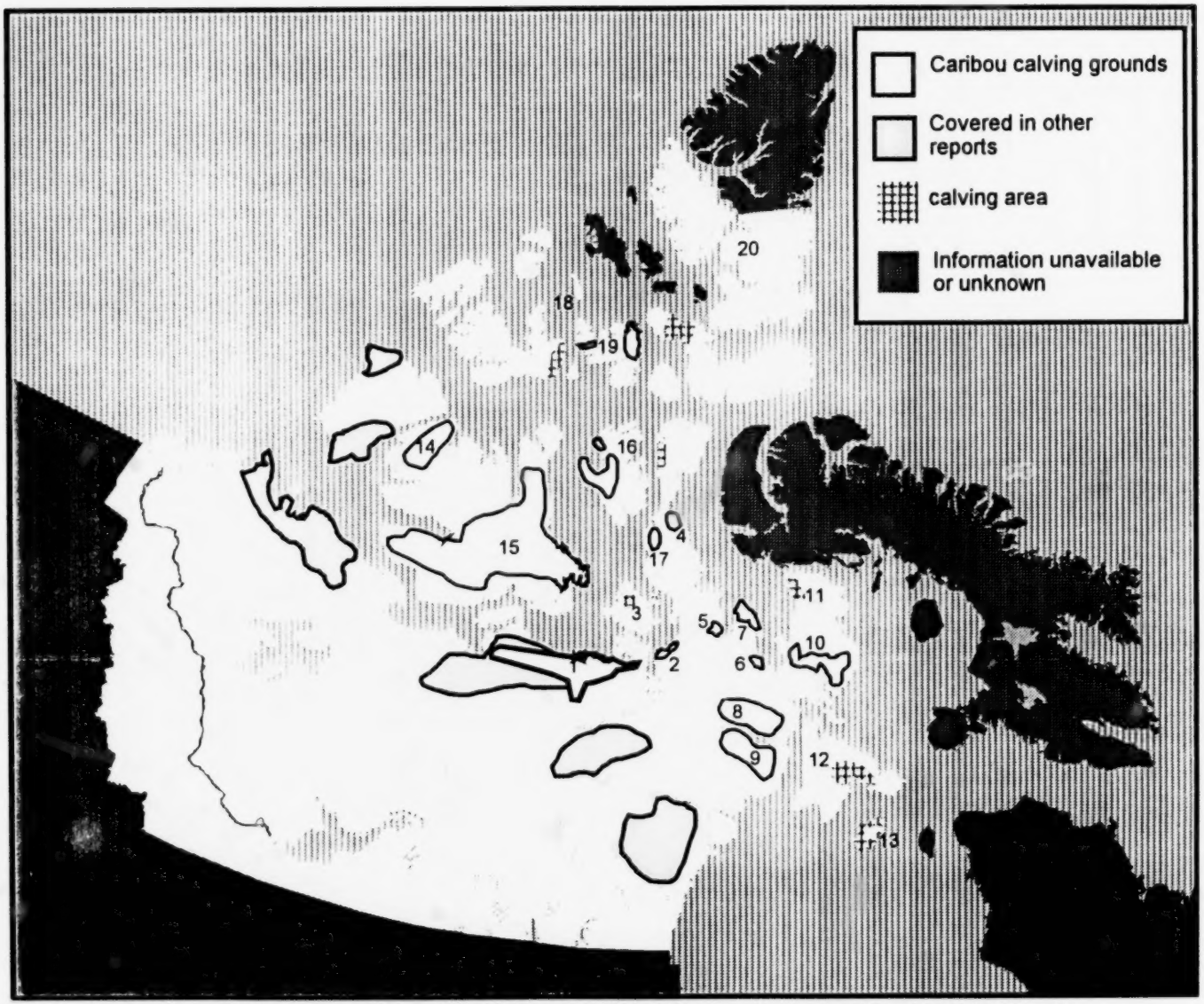

Figure 1. Caribou calving grounds and calving areas identified and substantiated in this report.

The remaining six areas identified for calving but not meeting our definition of a calving ground included two areas surveyed only once (King William Island, northern Melville Peninsula). For Prince Patrick and Melville islands, southern Ellesmere Island, and Southampton and Coats islands in west Hudson Bay, calving can be inferred from post-calving sightings of cows with calves but calving areas are only tentatively identified. However, we caution that the absence of identified calving areas does not reveal whether caribou do or do not have calving grounds on those islands. There are too few data to distinguish whether the caribou annually return to calving grounds or sites or whether they have alternate strategies.

Calving areas or calving grounds were not specifically identified on Coats Island partly because the reported surveys were during pre-calving and the post-calving survey reports lack maps and distributional information. For Southampton Island, original reports for the surveys are unavailable and the exact survey dates and cow-calf distribution are unknown.

On Prince Patrick and Melville islands, the information available for June is too sparse to document a calving ground. A calving ground has been documented for northern Bathurst and Massey islands with unsystematic surveys and satellite-collared cows. The absence of calving grounds on Melville and Prince Patrick islands may reflect a lack of information rather than a different calving strategy for those Peary caribou.

The difference between the calving areas (1 year with calving observations or calving inferred from post-calving observations) and calving grounds (at least 2 years of observations with calving overlap) is dependent on sampling frequency and reporting adequacy as well as possible calving strategy differences.

Infrequent sampling will mask whether or not there is an affinity to calving areas and the extent to which calving areas vary annually depending on environmental variation.

Aerial surveys provide information on caribou numbers and distribution but we have not attempted in this compilation to estimate the amount of overlap between years for any one calving ground. The data are too fragmentary and too few. A different scale of measuring affinity to calving grounds at the individual level comes from radio-tracking collared caribou. Those data are included in the compilation although sample sizes are small especially for satellite collars. The information from satellite collars is particularly useful for managing human activities as the collars allow remote monitoring of daily rates of travel during pre-calving, calving and post-calving as well as detailed comparisons of sites used between years.

The likelihood that we missed calving grounds for this compilation is unknown especially as caribou numbers on the mainland increased during the 1980s and caribou may have reoccupied previously used areas. Surveys in the 1970s did not locate calving grounds but observations made during ferry flights and the use of satellite telemetry led to the finding of Keith Bay and Boothia east calving grounds and local knowledge identified calving grounds on Simpson Lake and Simpson Peninsula. We have included pre-calving survey information and those surveys have been relatively extensive especially on the northeast mainland in 1983 and 1985. Those surveys identified concentrations of caribou close to known calving grounds and conversely, they did not identify concentrations remote from known calving grounds. However, the definitions of "concentration" and "close" could leave room for argument and we do not consider those pre-calving surveys as definitive for the presence or absence of calving grounds.

1. Queen Maud Gulf

Calving ground identification: The identification of a calving ground was based on the delineation of calving during aerial surveys in 1986 and 1996 with satellite collars providing 2 years of calving locations in 1996 and 1997 (Figure 2). Elders in Gjoa Haven had described caribou calving on the islands along the Queen Maud Gulf and aerial surveys in the mid-1970s recorded a few cows calving but did not delineate calving grounds. The calving grounds were first delineated during an aerial survey in 1986 and about that time hunters were reporting increasing numbers of caribou. The calving ground was delineated again in 1996 and the area overlapped the 1986 area, but the 1996 calving ground extended further west and overlapped with the calving grounds that the Bathurst herd had previously used until the mid-1980s (Sutherland and Gunn 1996).

Landscape and ecology: Characterized as coastal uplands and extensive marine silt plains of herbaceous tundra with an average elevation of 150m.

1. a) Pre-calving surveys

1975 **Fischer and Duncan 1976**

The authors flew aerial transect surveys to determine caribou numbers and distribution as part of the environmental assessment for a proposed gas pipeline from Hayes River to Baker Lake in May 1975 (Figure 3).

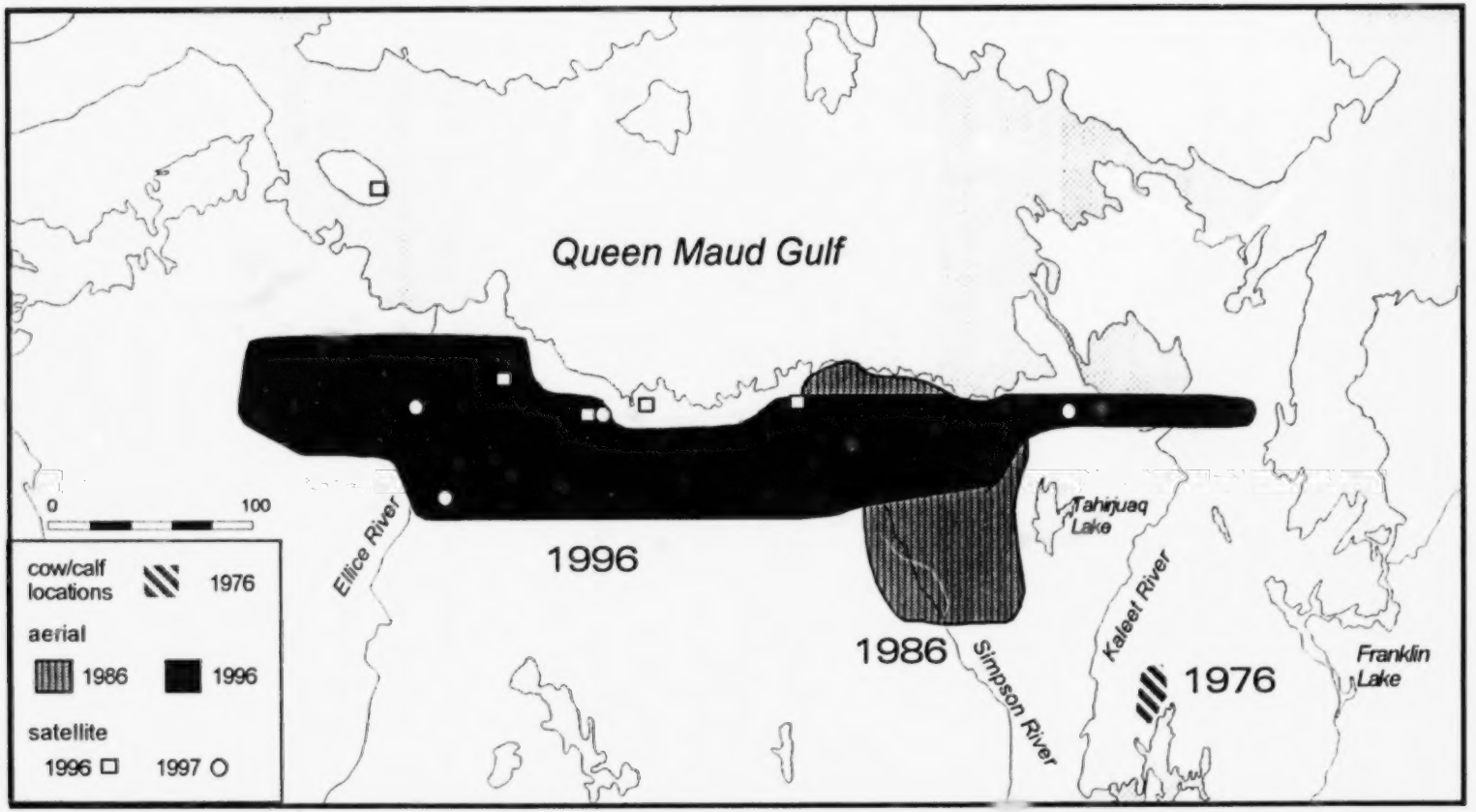

Figure 2. Queen Maud Gulf cow-calf locations, 1976, 1986, and 1996.

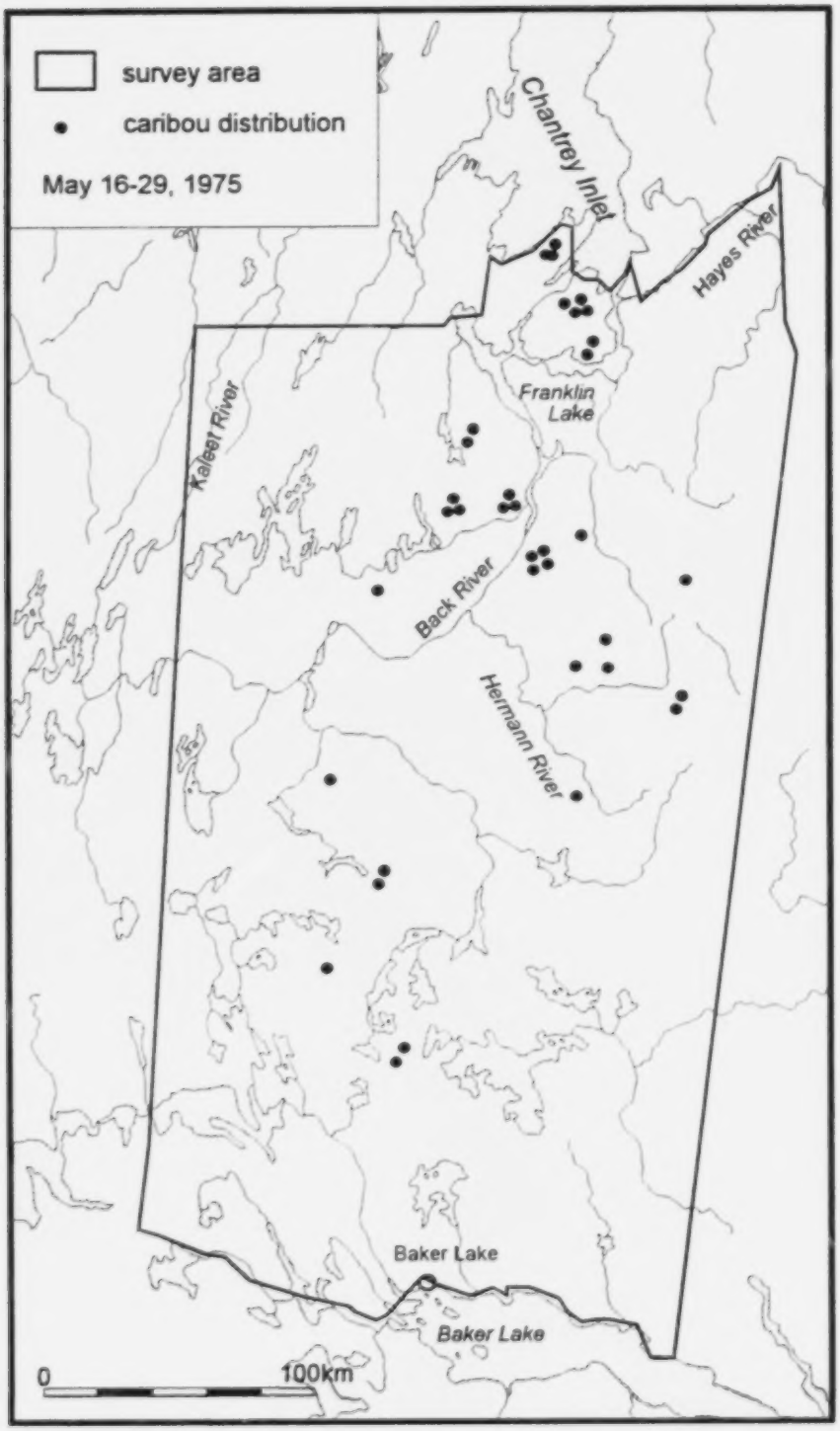

Figure 3. Hayes River to Baker Lake surv ey area, May 16-29, 1975,. Fischer and Duncan, 1975

1983 May 4-11 **Heard *et al.* 1987**

The authors flew this survey to determine pre-calving distribution and abundance of caribou in the Queen Maud Gulf area (Figure 4). No trends in movement out of the Queen Maud Gulf strata were detected. Authors suggest that Queen Maud Gulf animals are either a separate population or a segment of the Bathurst herd.

1995 May 24-26 **Buckland *et al.* in prep.**

This pre-calving distribution survey (Figure 5) used the same methods and timing as Heard *et al.* (1987). The authors found concentrations of caribou close to known calving areas in the northeast mainland including the Queen Maud Gulf.

1. b) Calving areas (early to mid- June, newborn calves seen)

1976 June 4-15 **Fischer *et al.* 1977**

The authors flew aerial transect surveys to determine numbers and distribution of caribou from Hayes River to Baker Lake in June 1976 using similar methods to their May 1975 survey. They reported a small concentration of cow-calf pairs west of Franklin Lake from 4 to 15 June 1976 (Figure 6).

1986 June 5, 11-12 **Gunn and Lambert in prep.**

The survey's objective was to determine caribou distribution and abundance on King William Island and Adelaide Peninsula and to locate caribou calving grounds. Calving had started by 5 June as during a single ferry flight along the coast, the authors saw 14 cows with four newborn calves on the small islands along the coast of Queen Maud Gulf. The survey between 11 and 12 June recorded a broad band of calving caribou from west of Tahirjuaq (McNaughton)

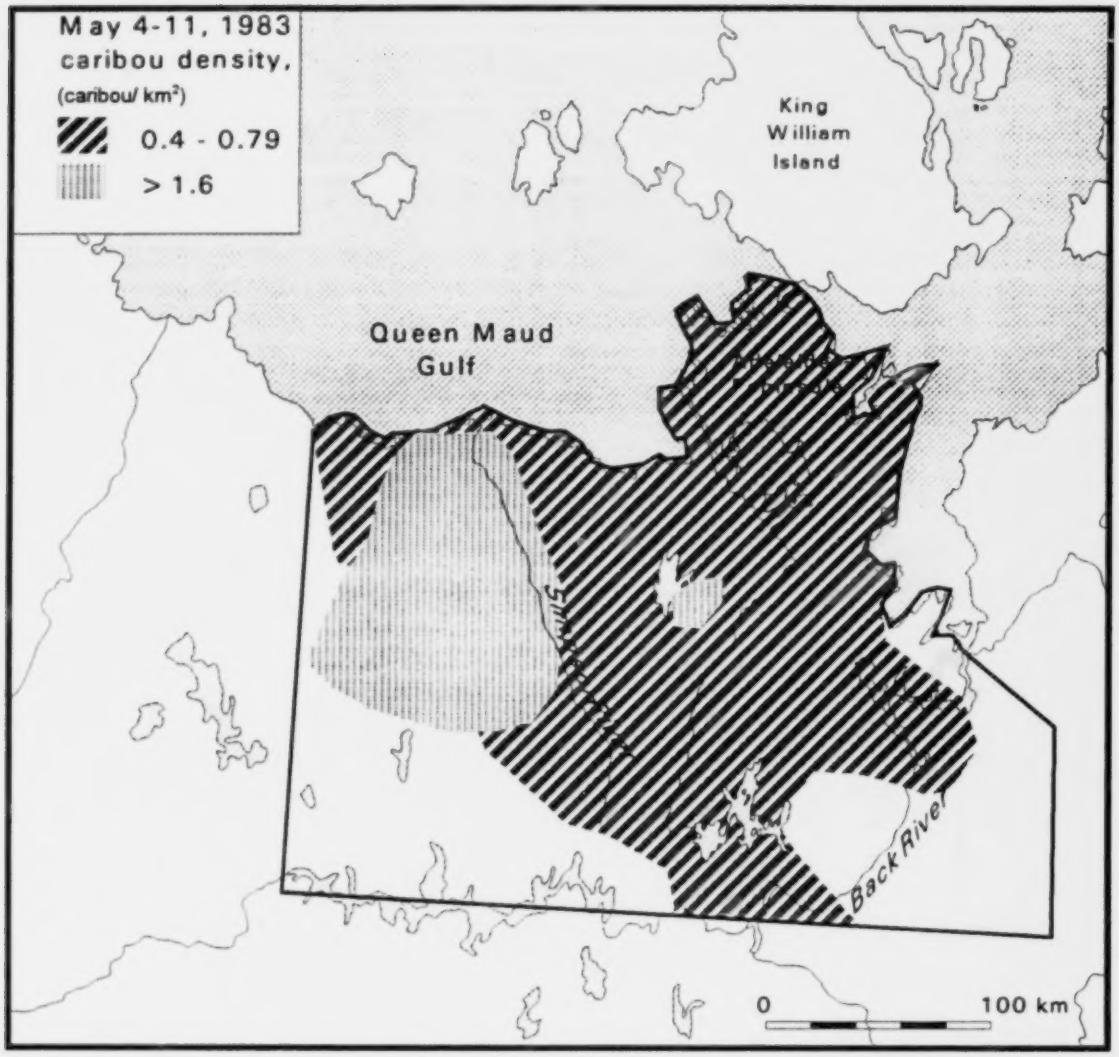

Figure 4. Queen Maud Gulf survey area, May 4-11, 1983, Heard *et al.* 1987.

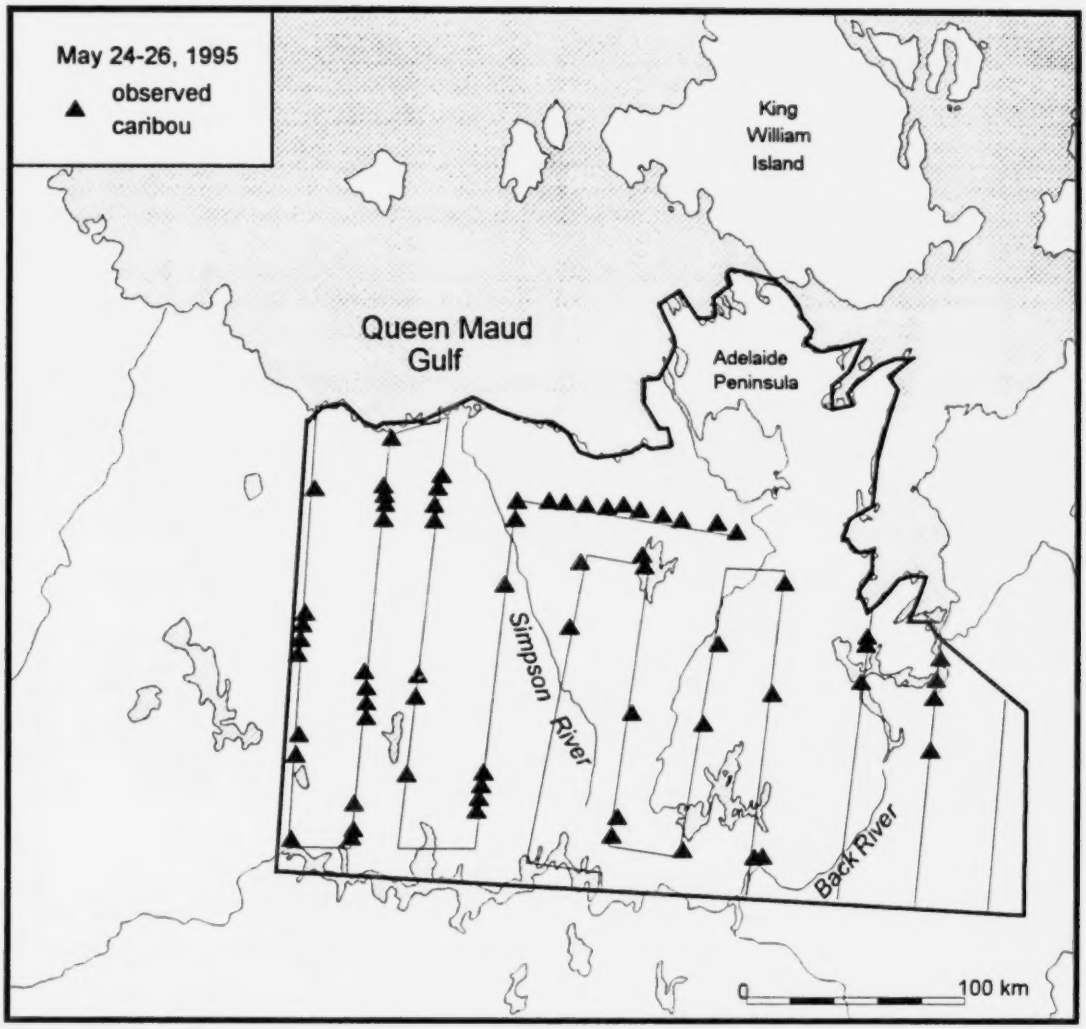

Figure 5. Queen Maud Gulf survey area, May 24-26, 1995, Buckland *et al.*, in prep.

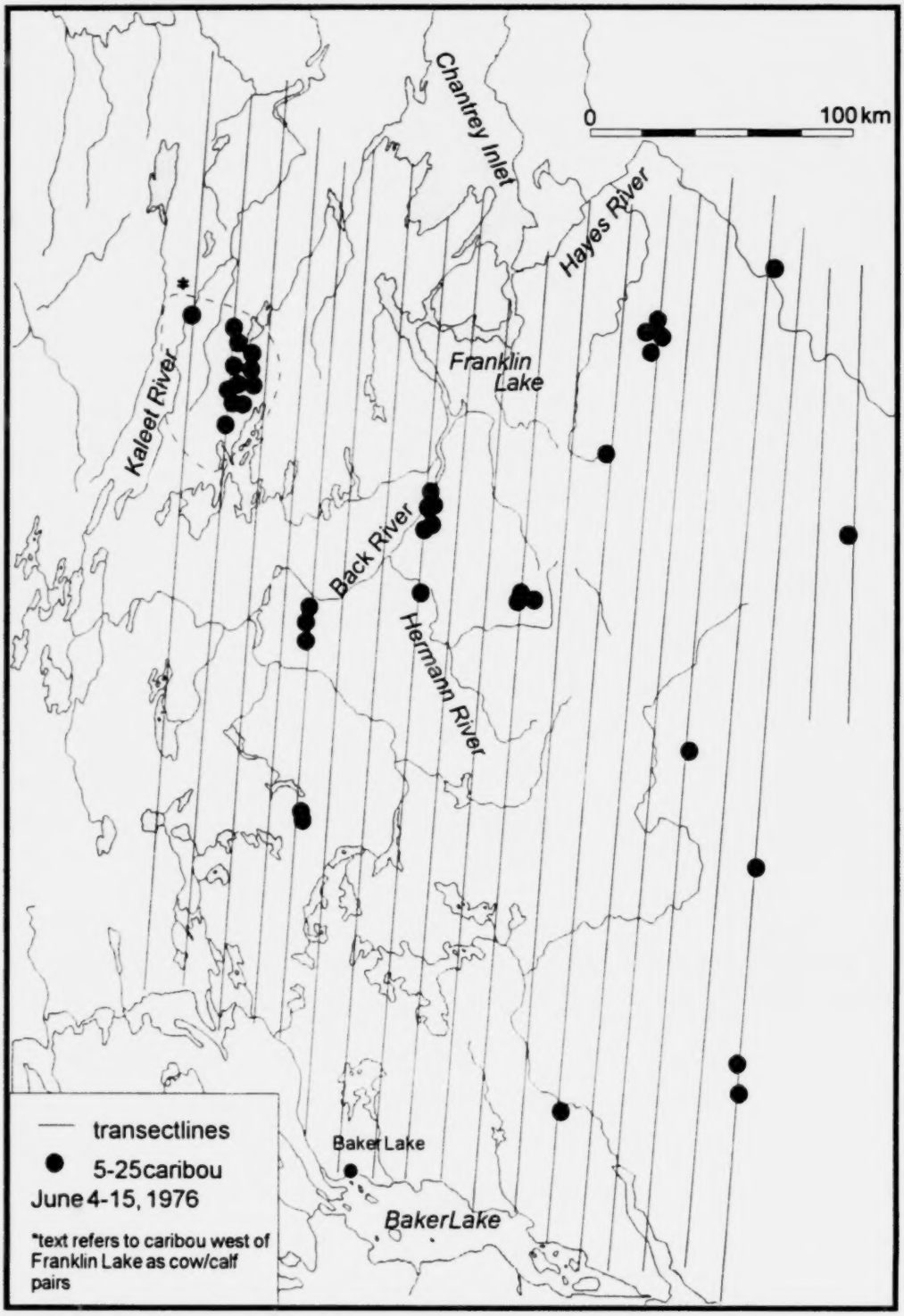

Figure 6. Hayes River to Baker Lake survey area, June 4-15, 1976, Fischer *et al.* 1976.

Lake along the coast to the mouth of the Simpson River and south to about the latitude of Kangowan Lake (Figure 7). The eastern boundary of the calving area based on cow-calf observations was within the area covered by east-west transects. North-south transects determined the western boundary and although weather was poor, only 1 cow-calf pair was seen west of the Simpson River although the transects continued further west. The southern boundary was determined by the last east-west transect line flown where only one cow-calf pair was observed. There was no discontinuity of distribution between those caribou calving on the islands off the coast of Queen Maud Gulf and the mainland.

1996 June 7, 12-13 **Gunn *et al.* 1997**

The authors conducted reconnaissance flights over the Queen Maud Gulf area in conjunction with a Bathurst calving ground survey to determine the boundaries of the calving area. The east-west boundaries were determined by flying for approximately 10 km after the last caribou seen on transect (Figure 8). The authors located the five satellite-collared cows within the coastal calving ground. In 1996, this calving area was separated from the calving area of the Bathurst caribou herd, west of Bathurst Inlet (Sutherland and Gunn 1996), by a distinct zone with only scattered caribou.

1. c) Post-calving surveys (late June/early July): none.

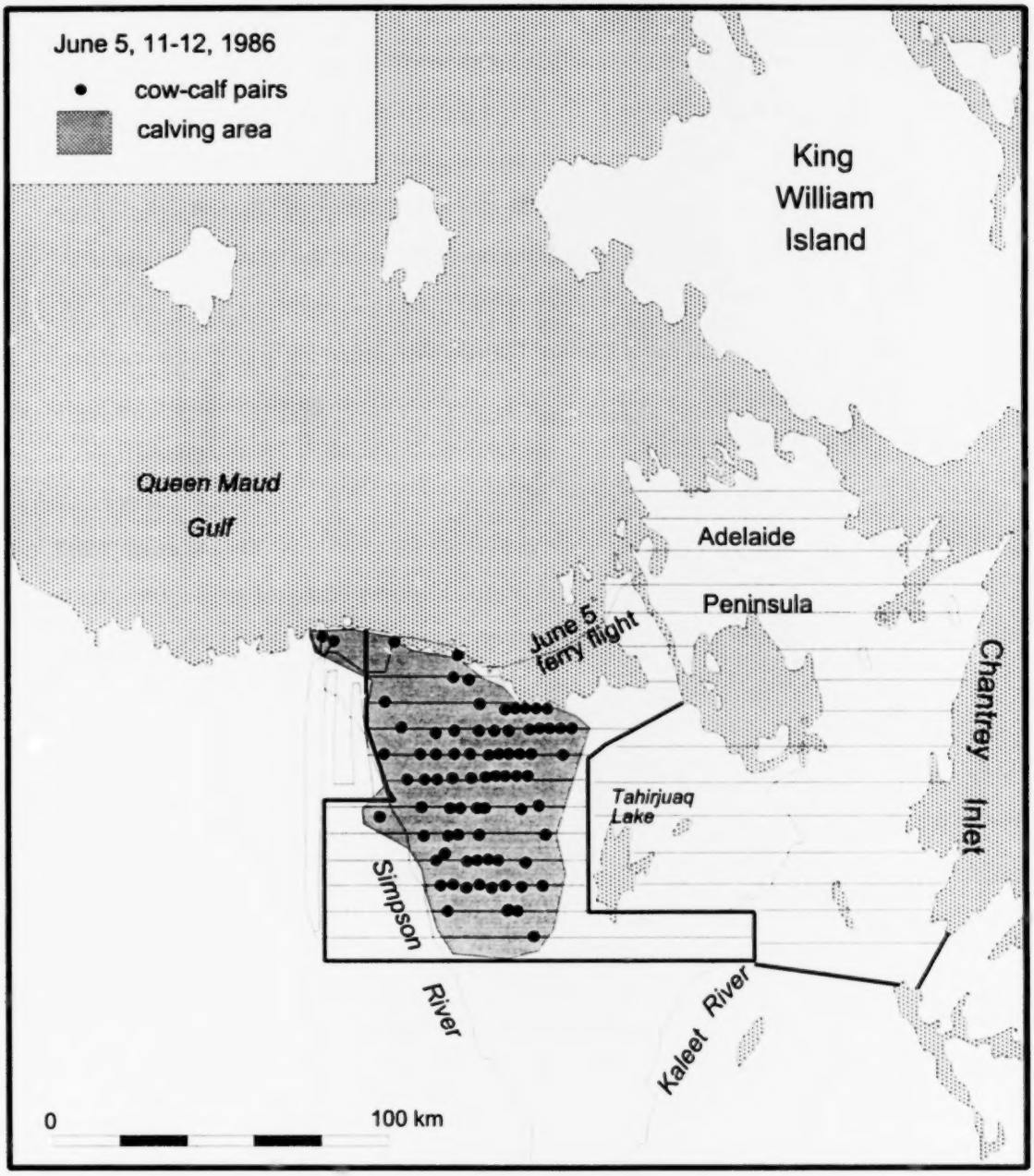

Figure 7. Queen Maud Gulf survey area, June 5-12, 1986, Gunn and Lambert, in prep.

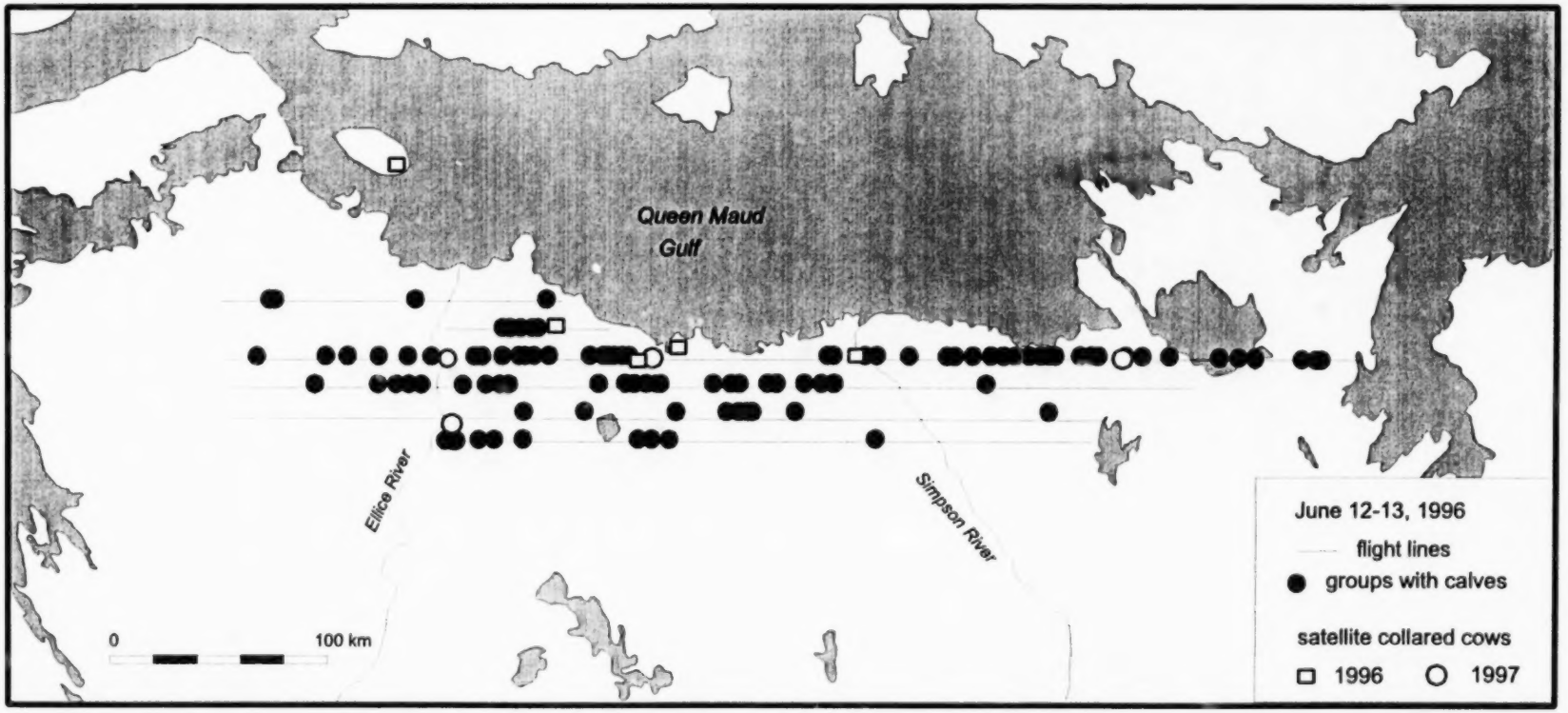

Figure 8. Queen Maud Gulf survey area, June 12-13, 1996, Gunn et al. 1997.

2. Arrowsmith Bay

Calving ground identification: The identification of a calving ground was based on the delineation of calving during aerial surveys in 1985 and 1986 with 3 subsequent years of calving observations that overlap (Figure 9). Both the 1985 and 1986 delineations were possibly incomplete as not all survey lines extended beyond the mapped calving distribution. Observations of calving during ferry flights in 1989 and 1991 were within the areas delineated in the 1980s. In 1985, Inuit from Gjoa Haven had identified that the lowlands may be used for calving. Relatively little has been published on these caribou, their herd identity, and their relationship to other herds.

Landscape and ecology: The Arrowsmith Lowlands are coastal lowlands (elevation 50-100 m) and are classified as herbaceous tundra with extensive areas of well-developed cotton-grass tussock meadows.

2. a) Pre-calving surveys (May to early June)

1983 May 4-11 **Heard *et al.* 1987**

This was an extensive low coverage systematic transect survey designed to estimate abundance and distribution over the northeast mainland. The survey was conducted during pre-calving when caribou were approaching their calving grounds. Weather was often better in May than in June and the snow background allowed for ease in tracking. The Arrowsmith Bay area (Figure 10) was part of one survey block. The report contains a map of caribou densities and distribution but no flight lines or caribou sightings along those lines.

1995 May 19-23 **Buckland *et al.* in prep.**

The 1983 survey was repeated in 1995 to obtain comparable estimates. Caribou numbers had increased and caribou were distributed relatively evenly across the survey block (Figure 11).

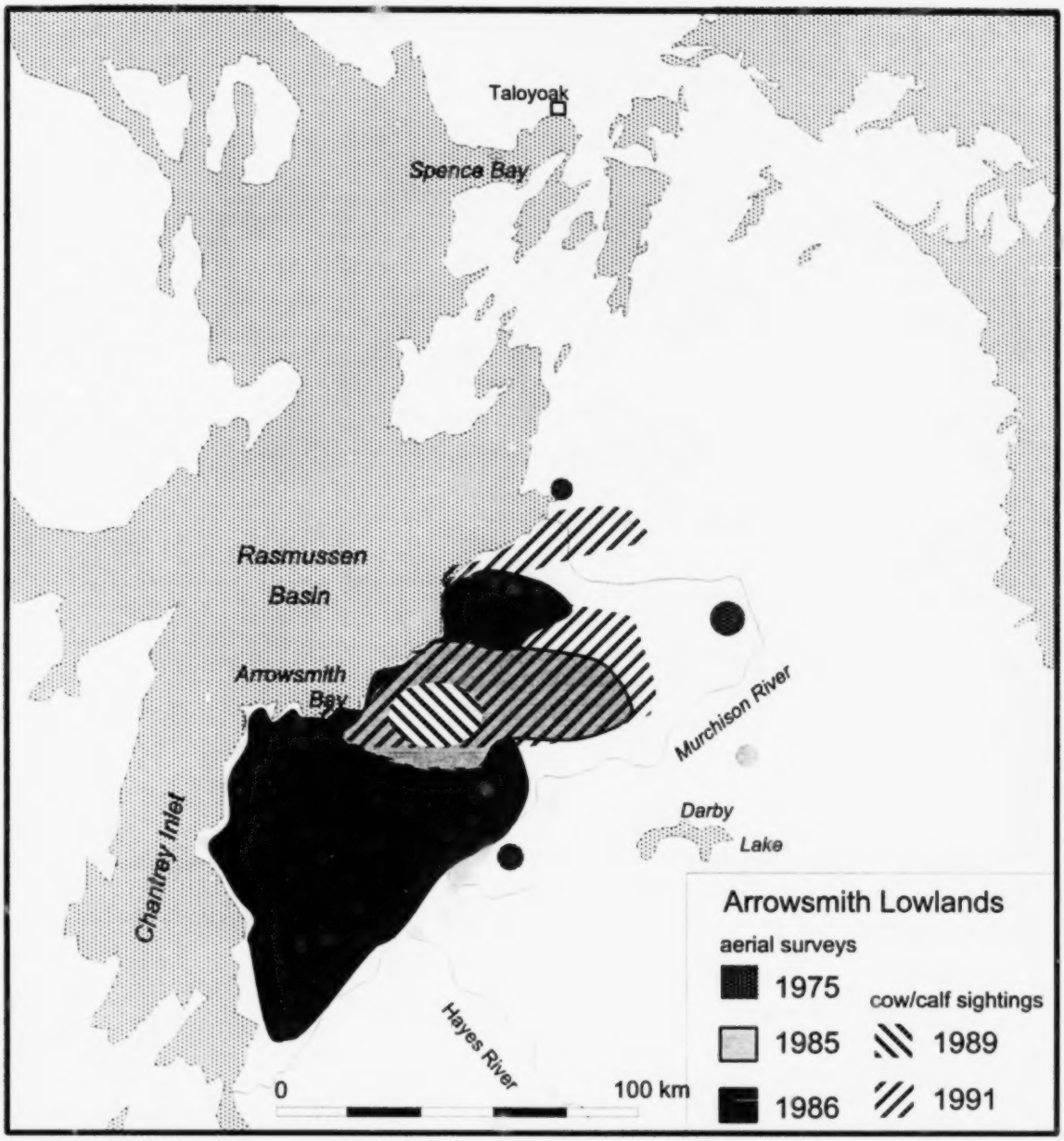

Figure 9. Arrowsmith Lowlands cow-calf locations, 1975-1991.

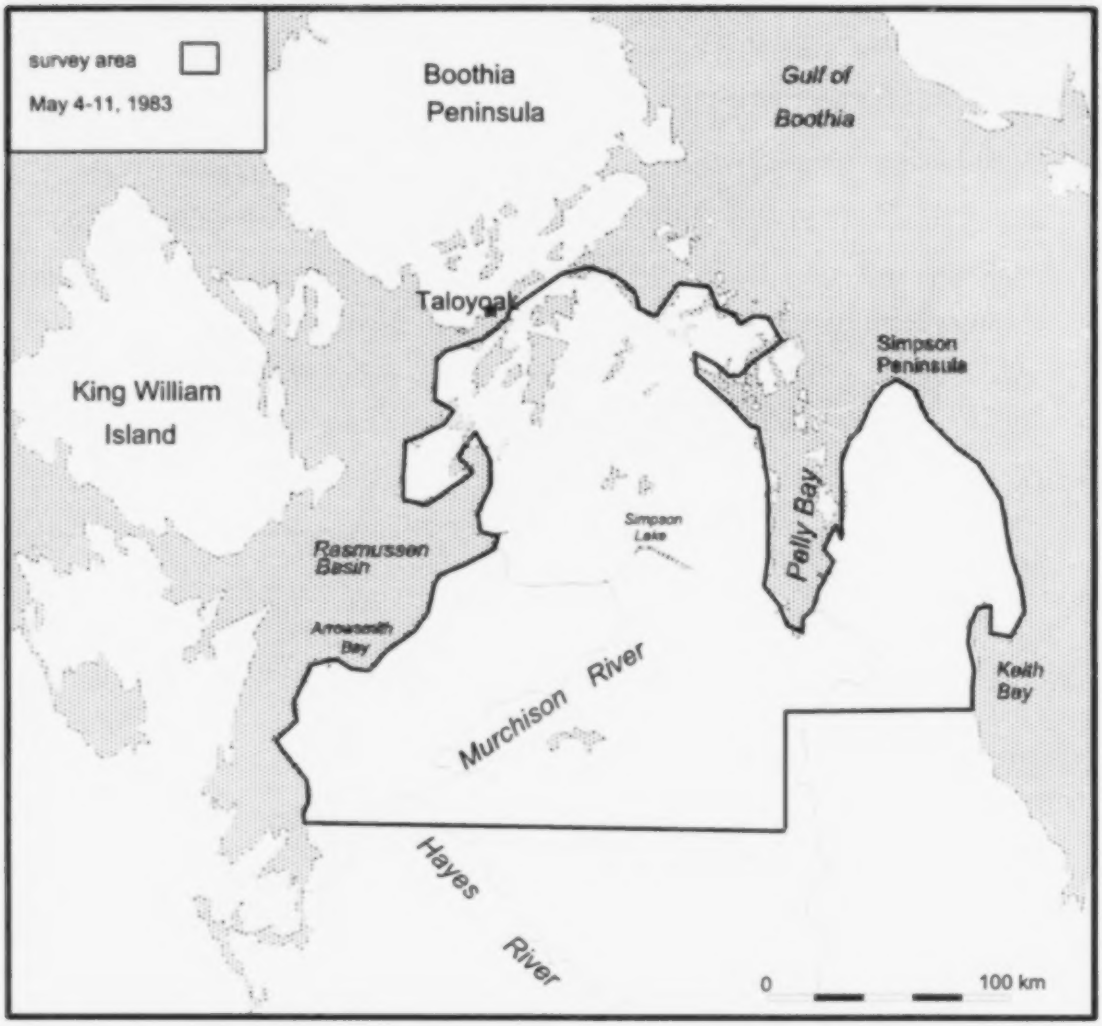

Figure 10. Spence Bay to Hayes River survey area, May 4-11, 1983, Heard *et al* . 1987.

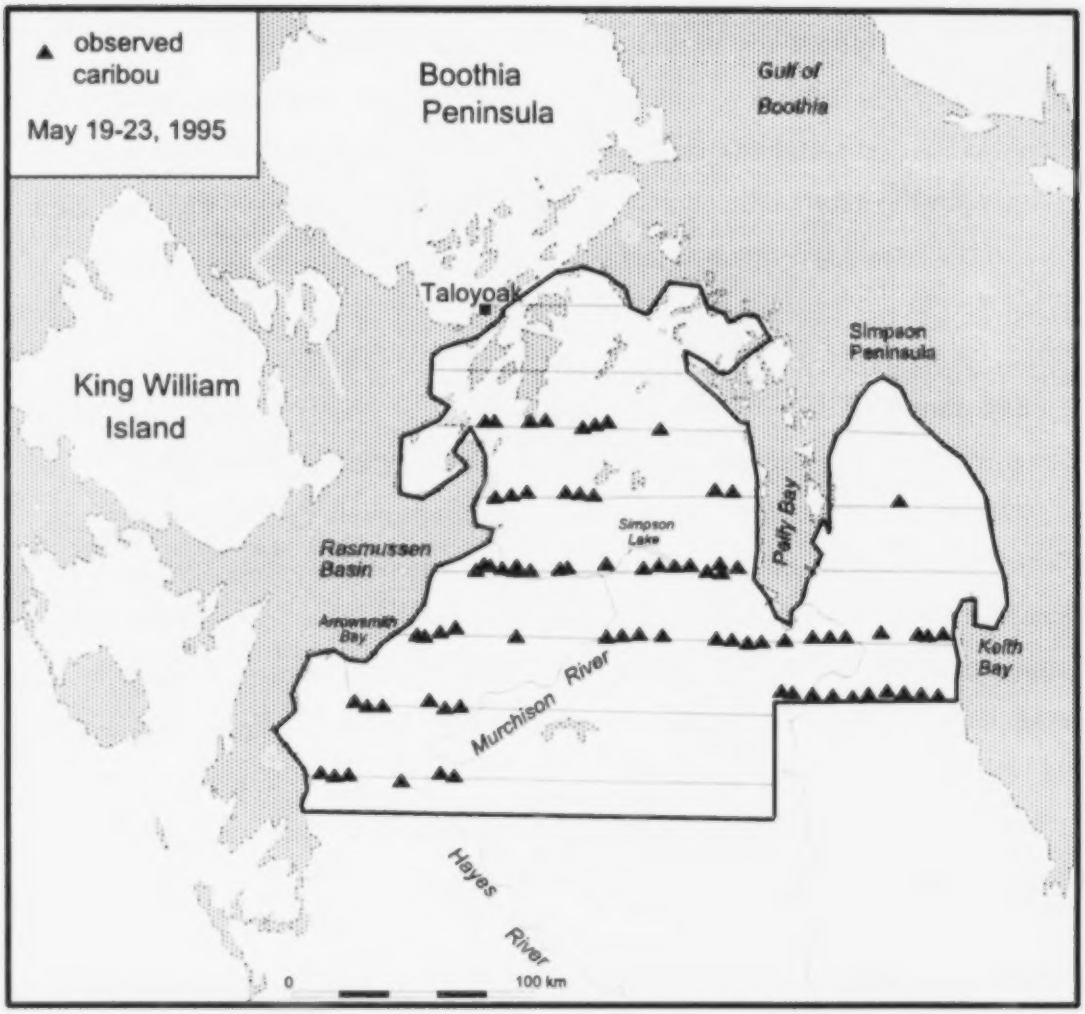

Figure 11. Spence Bay to Hayes River survey area, May 19-23, 1995, Buckland *et al.* in prep.

2. b) Calving areas (early to mid- June, newborn calves seen)

1975 May 31 - June 5 **Fischer and Duncan 1976**

This was the first systematic aerial survey of this area and it was designed to collect baseline information on abundance and distribution. The survey recorded six caribou including a cow and calf pair on the Arrowsmith Lowlands (Figure 12).

1985 June 7- 9 **Gunn and Ashevak 1990**

The systematic strip transect survey was designed to determine caribou abundance and distribution, especially calving distribution. On 9 June 1985, caribou south of Spence Bay were widely scattered in small groups, but on the coastal cottongrass meadows of Arrowsmith Bay, there were concentrations of cows with calves one to three days old (based on their appearance) along the two southernmost transects. The eastern boundary to the calving ground was in the hills west of Murchison River where only a few caribou were observed including three cow-calf pairs. The northern boundary was more conspicuous being marked by few and then no caribou toward the north (Figure 13).

1986 June 8-9 **Gunn and Lambert in prep.**

The objective of this systematic transect survey was to determine the distribution and abundance of caribou and to locate caribou calving areas. The survey area extended further south than in 1985 but not as far north or east (Figure 14). The cows were more scattered in 1986, but the tussock meadows were still snow-covered in contrast to 1985, when the snow had melted by the same time in June. The transects did not extend beyond the calving distribution and, consequently, delineation was unknown.

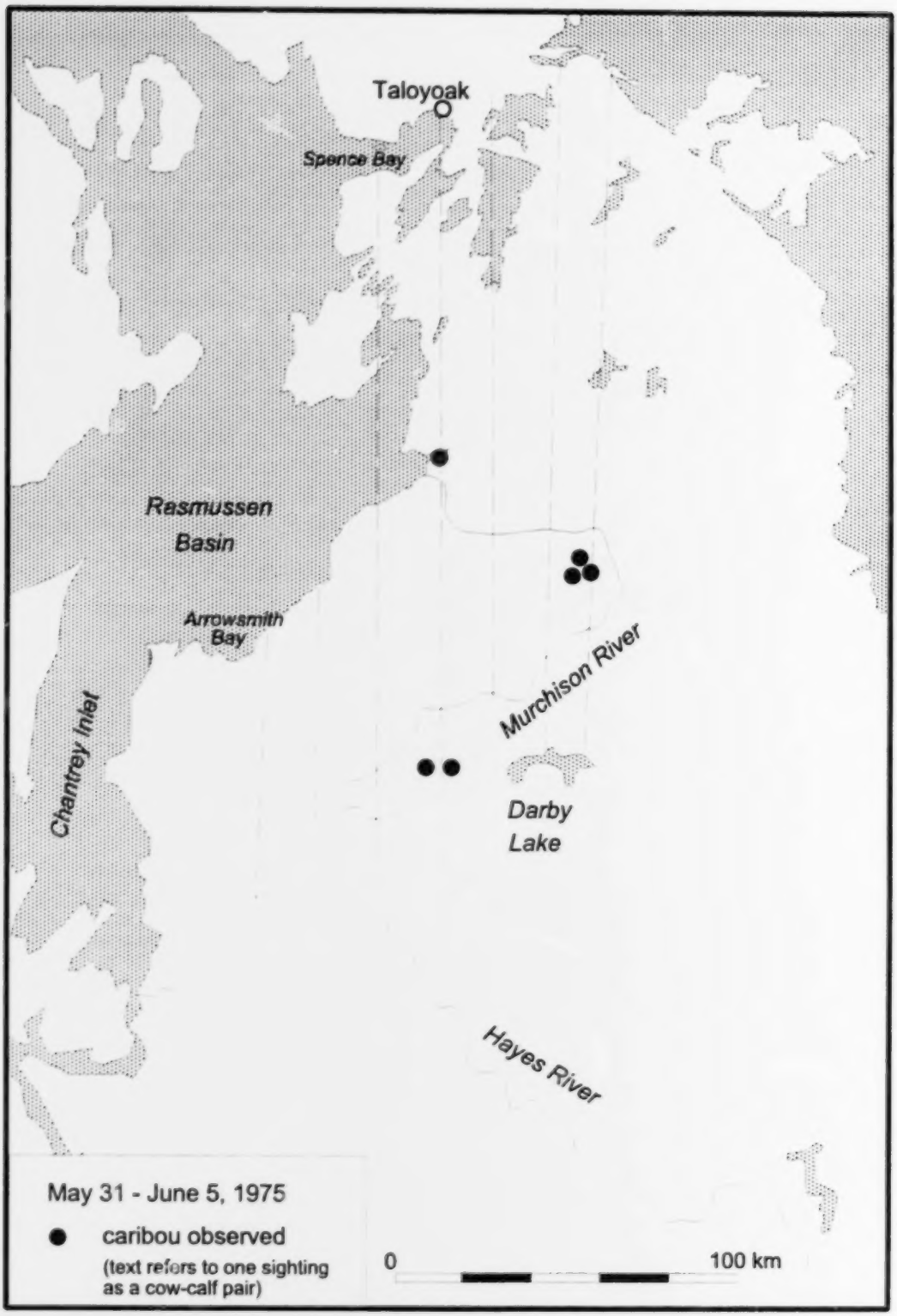

Figure 12. Arrowsmith Bay survey area, May 31 - June 5, 1975, Fischer and Duncan 1976.

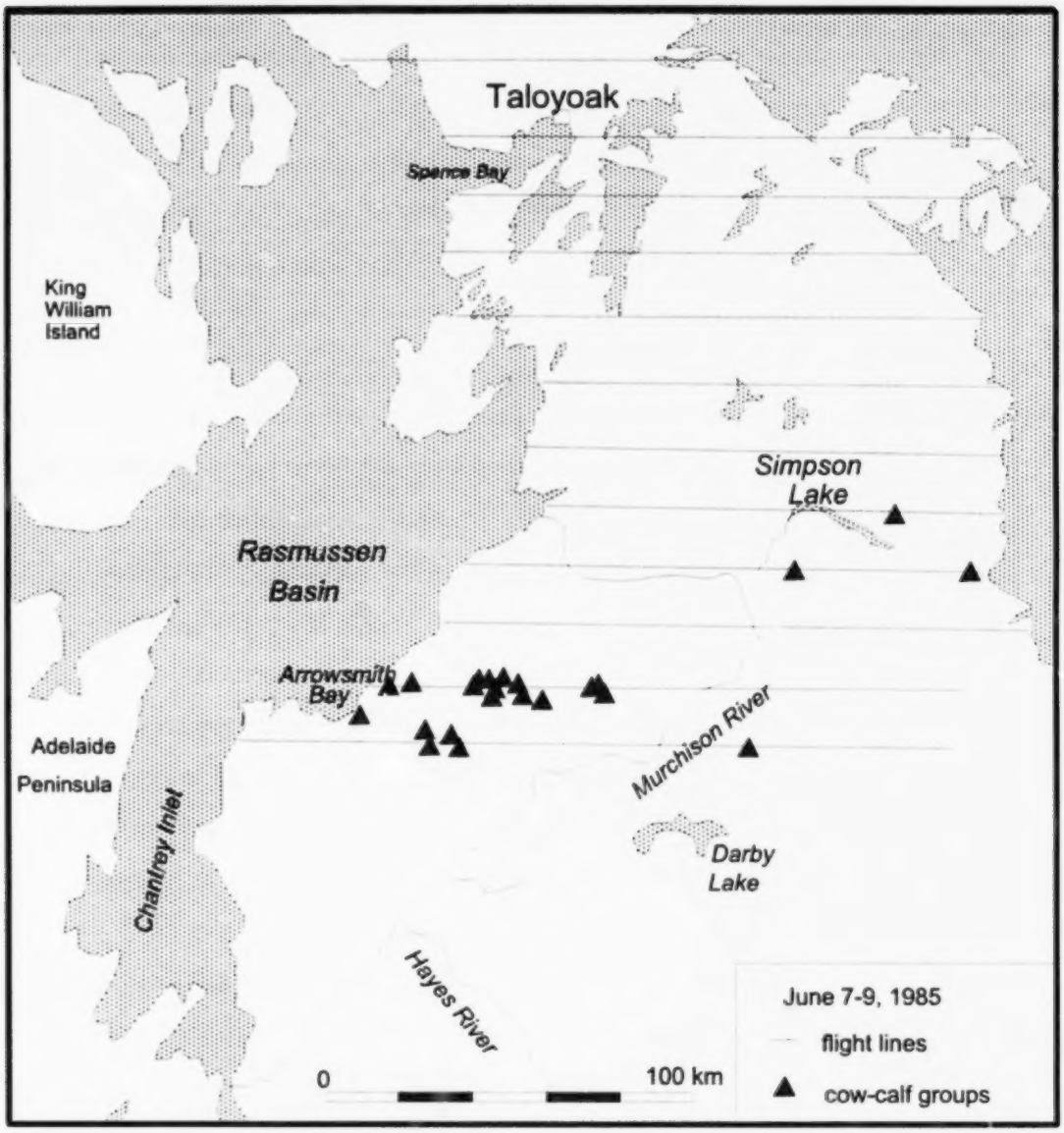

Figure 13. Spence Bay to Hayes River survey area, June 7-9, 1985, Gunn and Ashevak 1990.

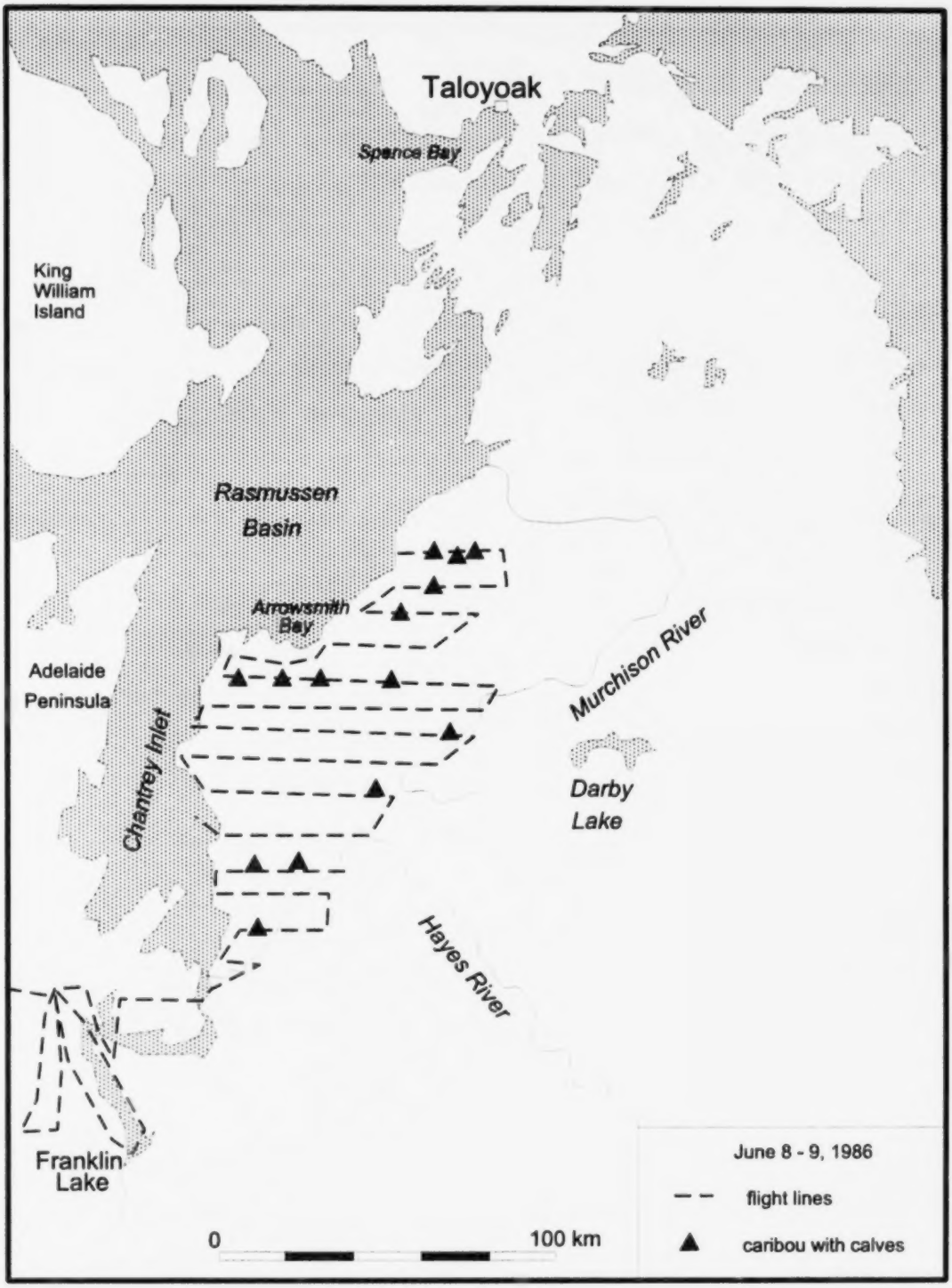

Figure 14. Arrowsmith Bay survey area, June 8-9, 1986, Gunn and Lambert in prep.

1989 and 1991 June 12 **Gunn and Fournier in prep. a.**

During ferry flights between Gjoa Haven and Taloyoak on 12 June, the Arrowsmith Lowlands were overflown to check if the area was being used for calving. The tussock meadows were mostly snowfree and, during a single ferry flight on 12 June 1989 (the systematic survey is reported on in the section on Simpson Lake), we counted 77 caribou including seven newborn calves (Figure 15). In 1991 on 12 June, we counted 178 caribou, mostly cows and subadults, and including 18 newborn calves (Figure 16). Most cows still had their hard antlers, which suggested that calving had only just begun. The flight lines were not extensive enough to delineate the calving ground.

2. c) Post-calving surveys (late June/early July)

1976 July 1,3,4 **Fischer *et al.* 1977**

Twenty-six caribou were observed during a survey (12.6% coverage) between Spence Bay and Hayes River, an area of 34 847 km^2. More than half of the animals were north of Hayes River and south of Rasmussen Basin (Figure 17). The report has maps of caribou locations along transect lines.

3. King William Island

Calving ground identification: As the only calving information was from one year (1986), a calving ground was not identified. The sighting of cow-calf pairs on King William Island during the only aerial survey in 1986 was the basis for identifying northern King William Island as a calving area. Historically, caribou calved in the island's interior but by the 1920s and 1930s, the caribou had disappeared from King William Island. In the 1980s, hunters were reporting that caribou were returning to King William Island.

Landscape and ecology: flat lowlands of bare ground tundra vegetation.

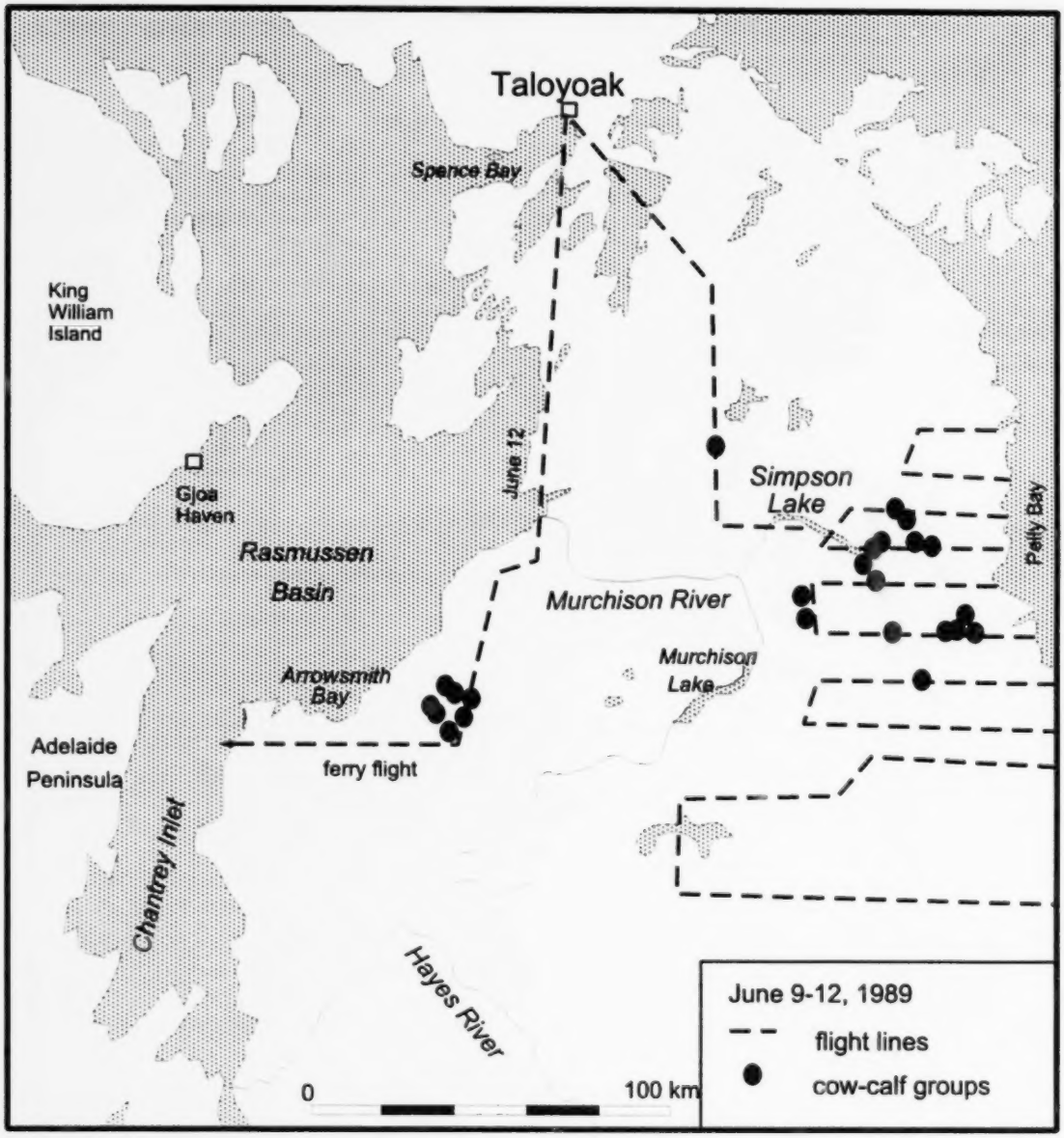

Figure 15. Spence Bay to Hayes River survey area, June 9-12, 1989, Gunn and Fournier in prep.

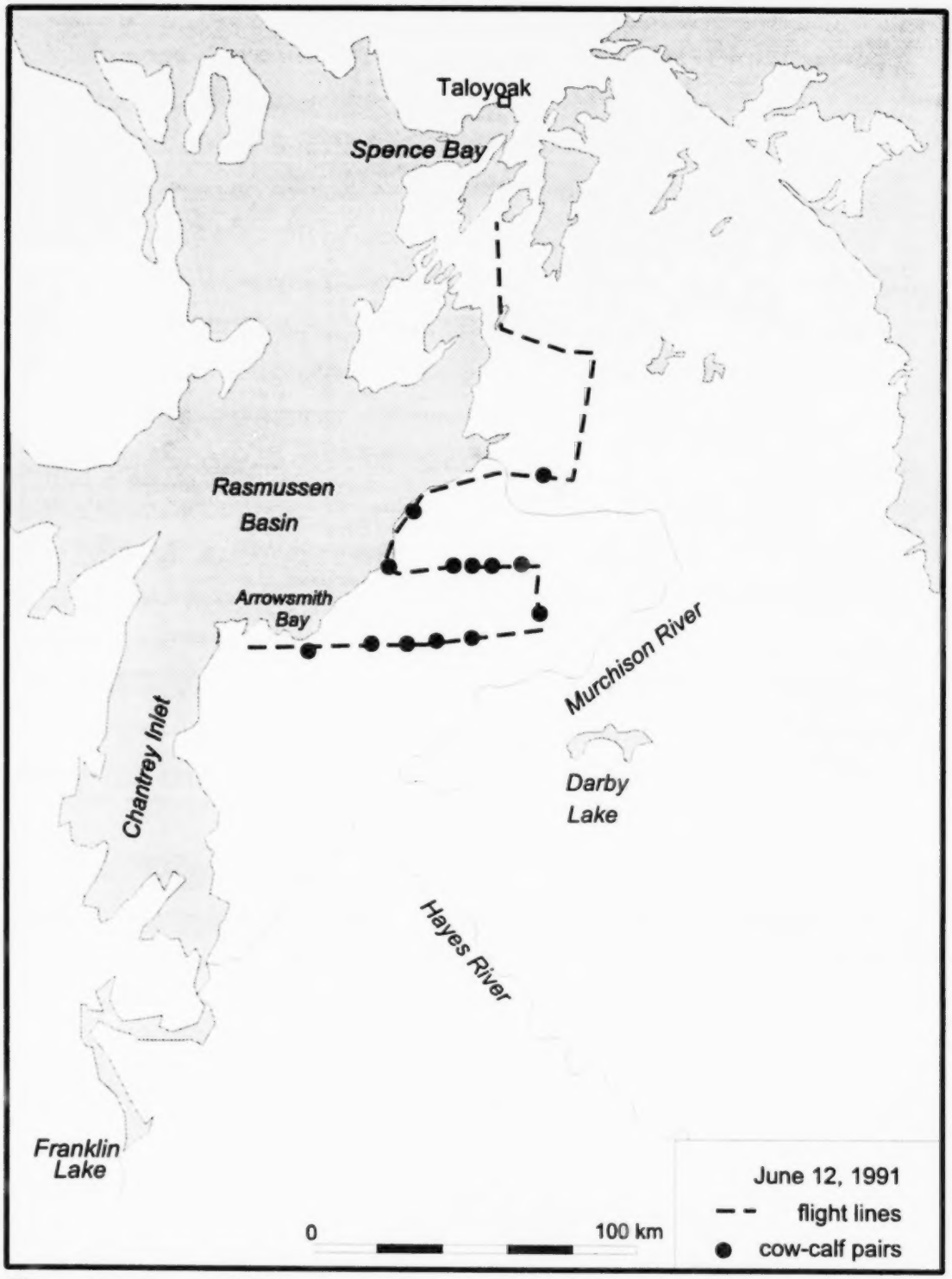

Figure 16. Arrowsmith Bay survey area, June 12, 1991, Gunn and Fournier in prep.

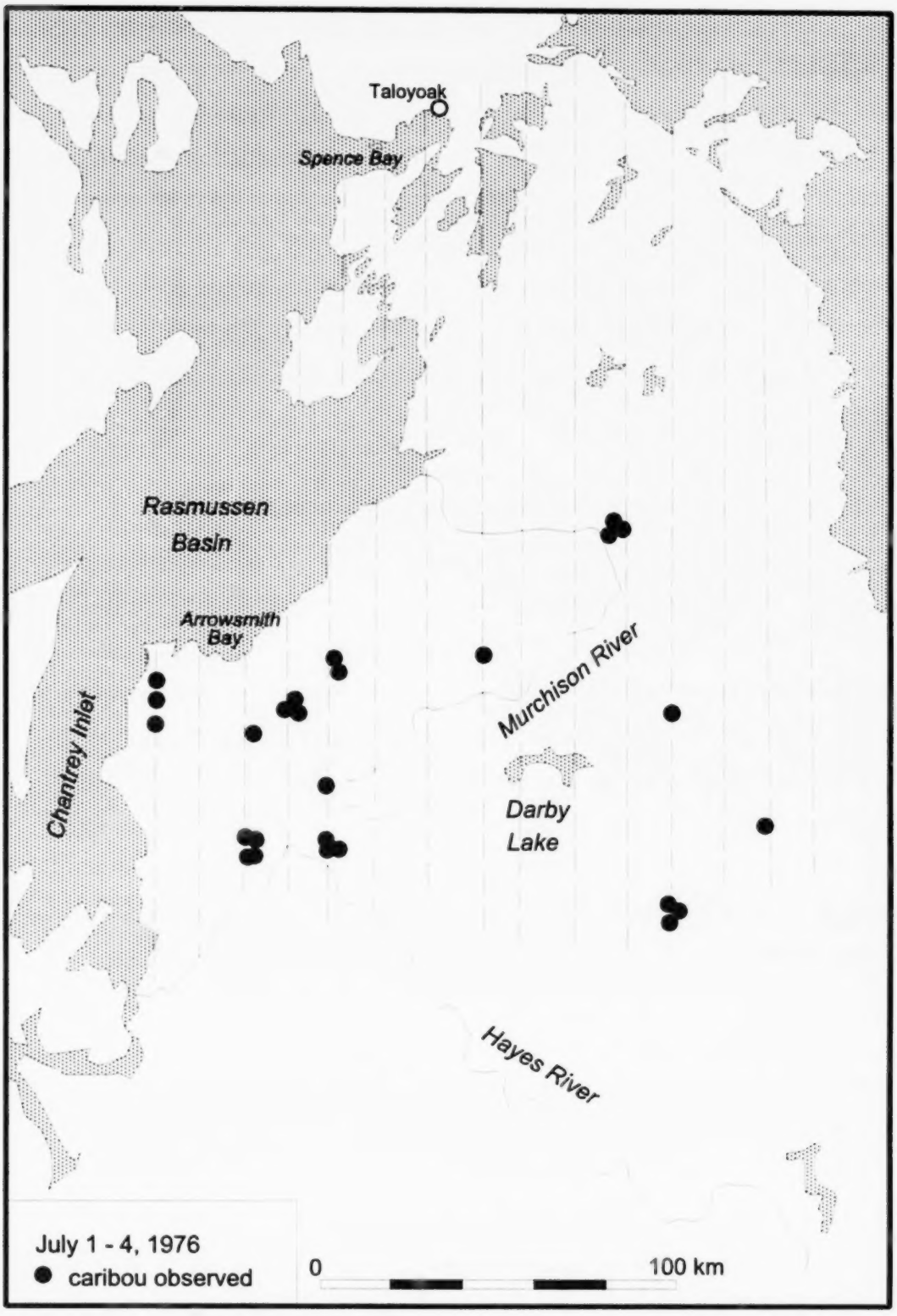

Figure 17. Spence Bay to Hayes River survey area, July 1-4, 1976, Fischer *et al.* 1977.

3. a) Pre-calving surveys: none.

3. b) Calving areas (early to mid- June, newborn calves seen)

1986 June 10-11 **Gunn and Lambert in prep.**

An aerial survey was conducted to determine the distribution and abundance of caribou and muskoxen on King William and Matty islands and to locate areas used for calving (Figure 18). Three cow-calf pairs were observed in the interior of King William Island. The calves looked to be two to three days old and two cows had shed their antlers. Three cows with hard antlers were seen on Matty Island.

3. c) Post-calving surveys (late June/early July): none.

4. Boothia Peninsula - east

Calving ground identification: The identification of barren-ground caribou calving on northeast Boothia was previously unreported. It was identified when, despite small sample sizes, satellite-collared cows calved on northeast Boothia Peninsula in 1991, 1992 and 1993 (Figure 19). The calving ground was not delineated during systematic aerial surveys in 1975 and 1985 as no cows and calves were seen on eastern Boothia Peninsula. Caribou numbers have increased on Boothia Peninsula and the evidence, although fragmentary, suggests a recolonization of eastern Boothia Peninsula by barren-ground caribou.

Landscape and ecology: characterized as hilly and rugged, with sparsely vegetated herbaceous and bare ground tundra.

4. a) Pre-calving surveys (May to early June): none.

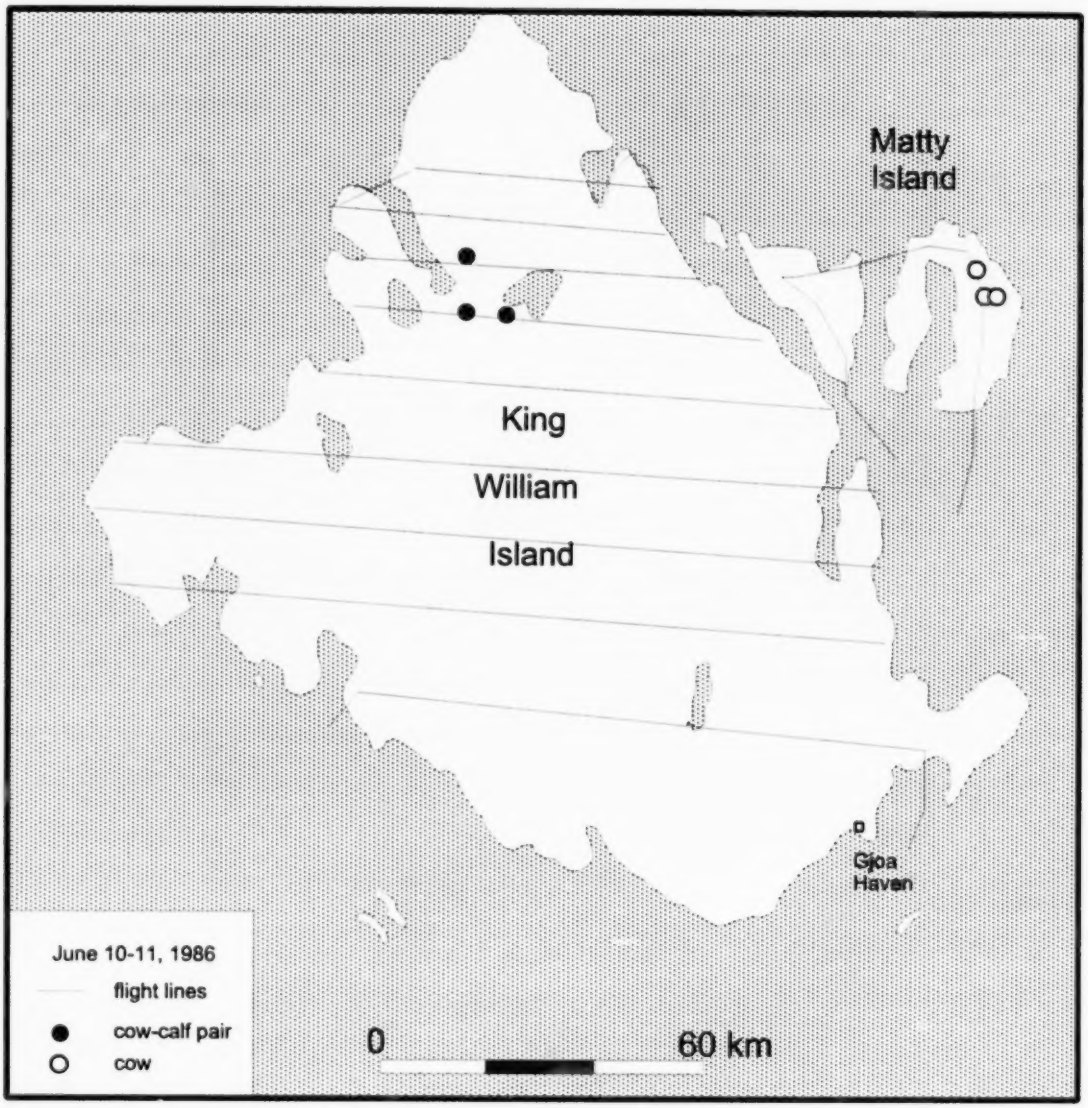

Figure 18. King William Island survey area, June 10-11, 1986, Gunn and Lambert in prep.

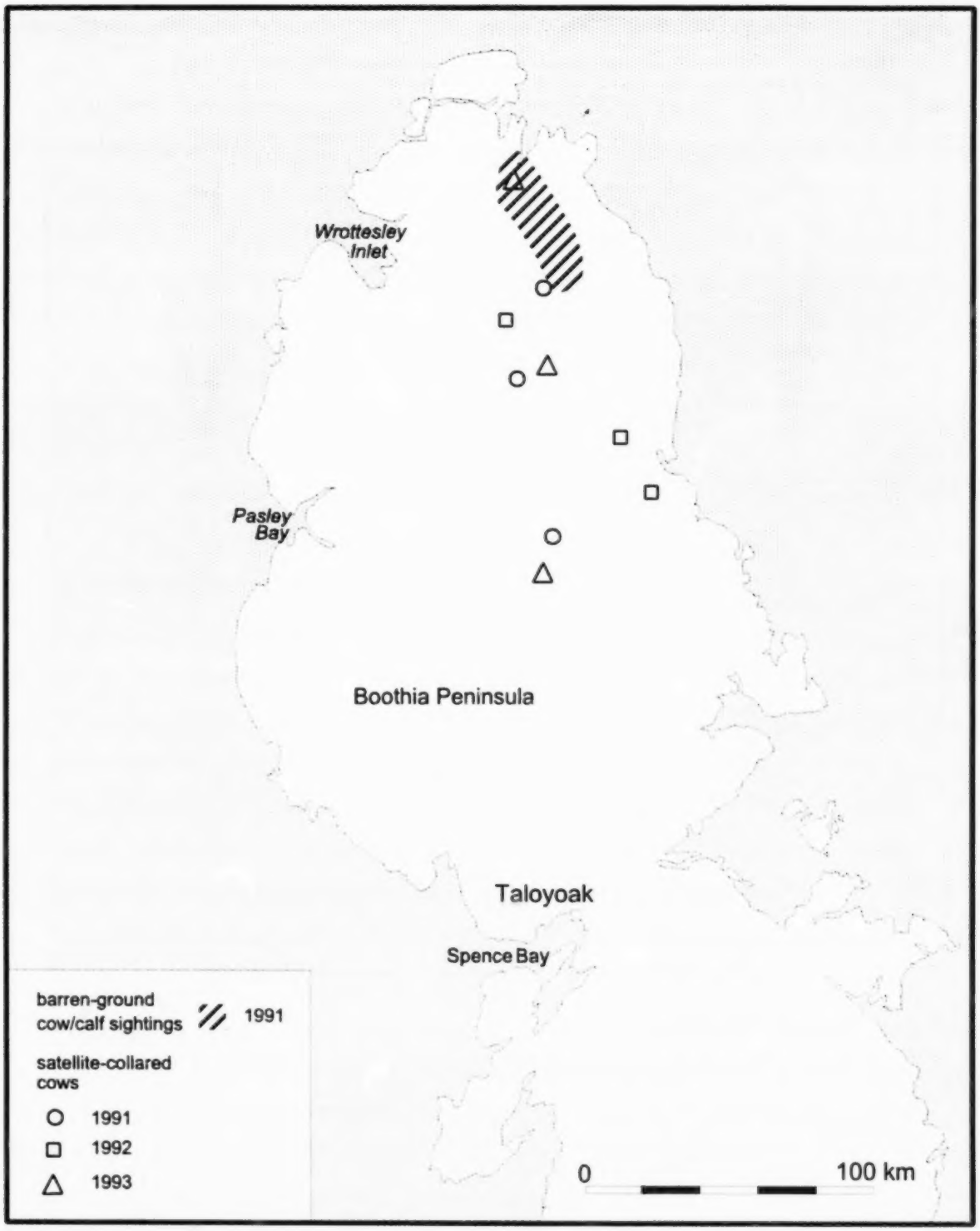

Figure 19. Boothia Peninsula barren-ground caribou cow locations in June, 1991-93, Gunn and Fournier in prep.

4. b) Calving areas (early to mid- June, newborn calves seen)

1974 May- June, 1975 June **Fischer and Duncan 1976**

Surveys were conducted to collect baseline information of wildlife abundance and distribution along the proposed route of a gas pipeline. The authors flew transect surveys to determine seasonal numbers and distribution of caribou. The entire Boothia Peninsula was surveyed but cows and calves were not recorded on eastern Boothia.

1985 May 31 - June 13 **Gunn and Ashevak 1990**

A systematic strip transect survey for caribou covered Boothia Peninsula, but no cows and calves were recorded on eastern Boothia Peninsula. However, as the survey dates were 3-4 June, calving may not have started in the east. The caribou were scattered on the eastern coastal lowlands and were mostly bulls and juveniles. Their pale antler colour (as far as it was discernable from the aircraft) suggested that those caribou were arctic-island caribou. A single group on central Boothia was noted as having dark pelage although there was no new antler growth.

1991 - 1993 **Gunn and Fournier in prep. a.**

Six cows were fitted with satellite collars in March 1991 to track their movements on Boothia Peninsula. Three of the six were barren-ground and three were arctic-island caribou. In June 1991-93, the cows were visually located to determine if they were pregnant (hard antlers), had calved, or were probably non-breeders (no antlers). The visual check was to find out which June locations were calving locations as not all non-breeding cows reach the calving grounds. We also noted if other cows were calving in the immediate vicinity although we did not attempt to delineate calving ground boundaries (Figure 19).

On 13 June 1991, one collared barren-ground cow had a newborn calf on northeast Boothia and the other two cows were on central Boothia: one cow was pregnant and one was probably a non-breeder. The cow that had calved had two cow-calf pairs and other cows in her vicinity (Figures 20 and 21).

Sightings of other caribou were not recorded during the visual checks of the collared cows in 1992 and 1993. On 15 June 1992, the three collared barren-ground caribou were pregnant: two were on eastern Boothia and the third was on central Boothia Peninsula (Figure 22). In June 1993, the one pregnant barren-ground caribou was found on northeast Boothia in a similar location to 1991 (Figure 23). The barren-ground cow that had not been pregnant in 1991 was again not pregnant and was also on central Boothia. The third barren-ground collared cow was not located.

17. c) Post-calving surveys (late June/early July): none.

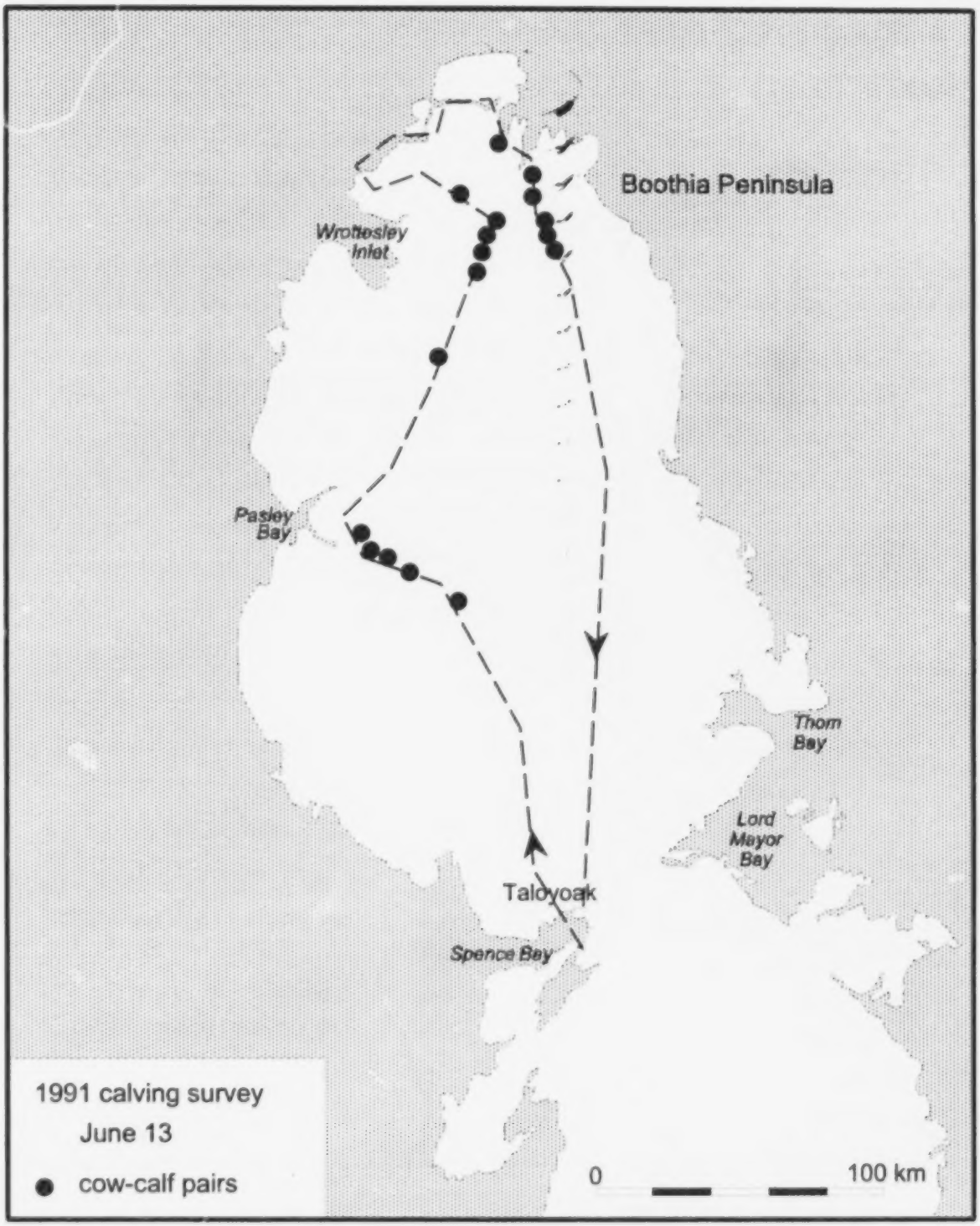

Figure 20. Boothia Peninsula calving survey, June 13, 1991, Gunn and Fournier in prep.

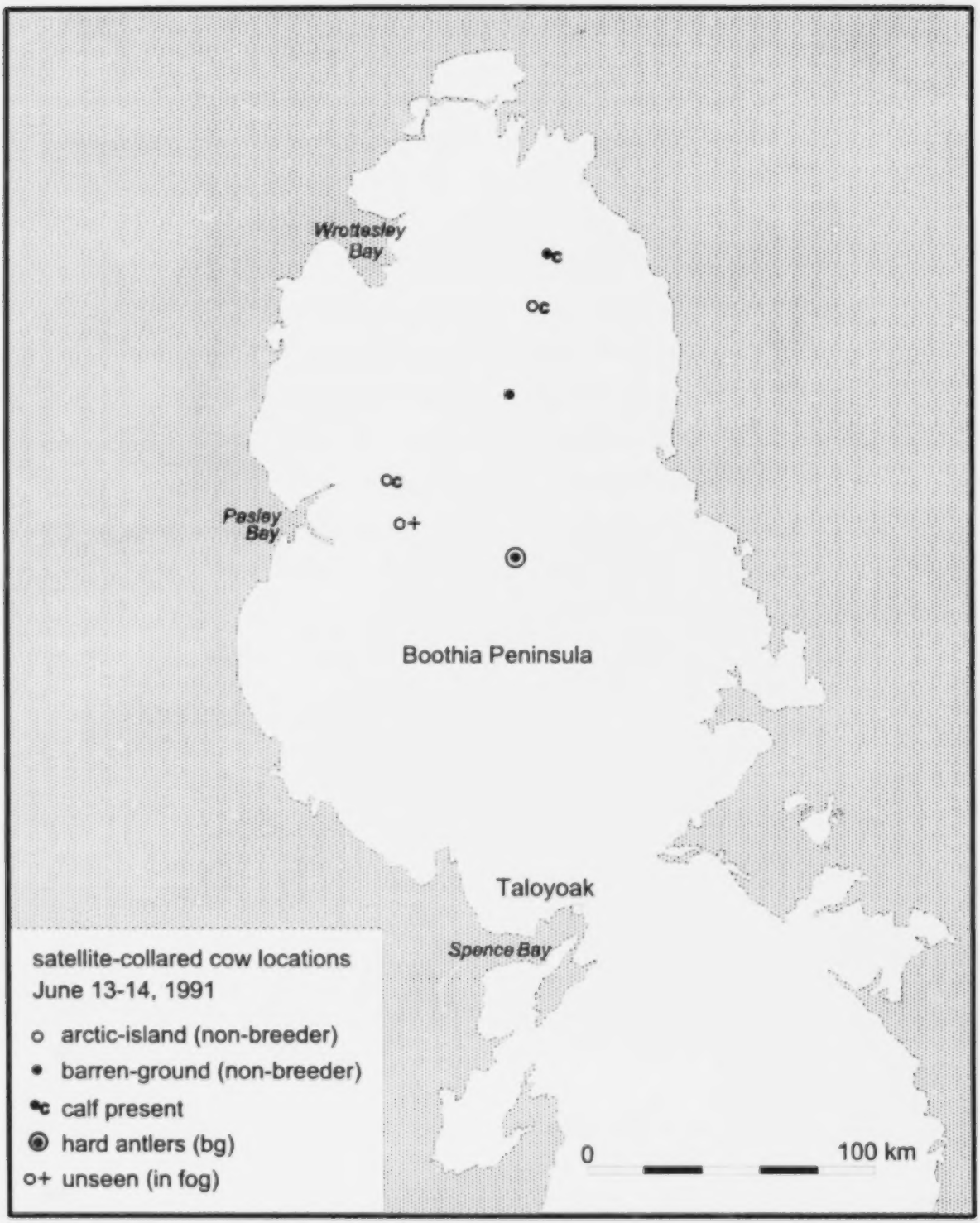

Figure 21. Satellite-collared cow locations on Boothia Peninsula, June 13-14, 1991, Gunn and Fournier in prep.

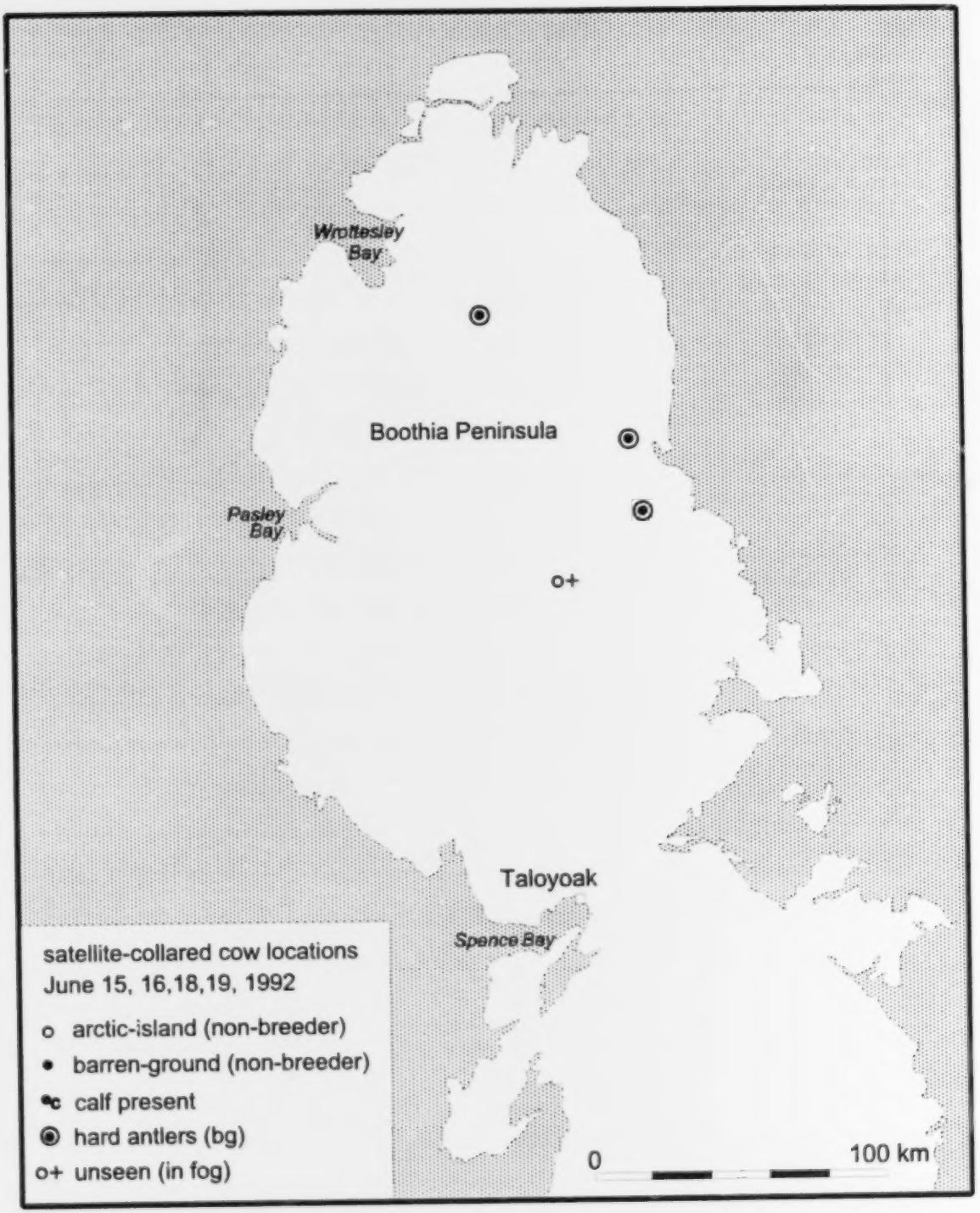

Figure 22. Satellite-collared cow locations on Boothia Peninsula, June 15-19, 1992, Gunn and Fournier in prep.

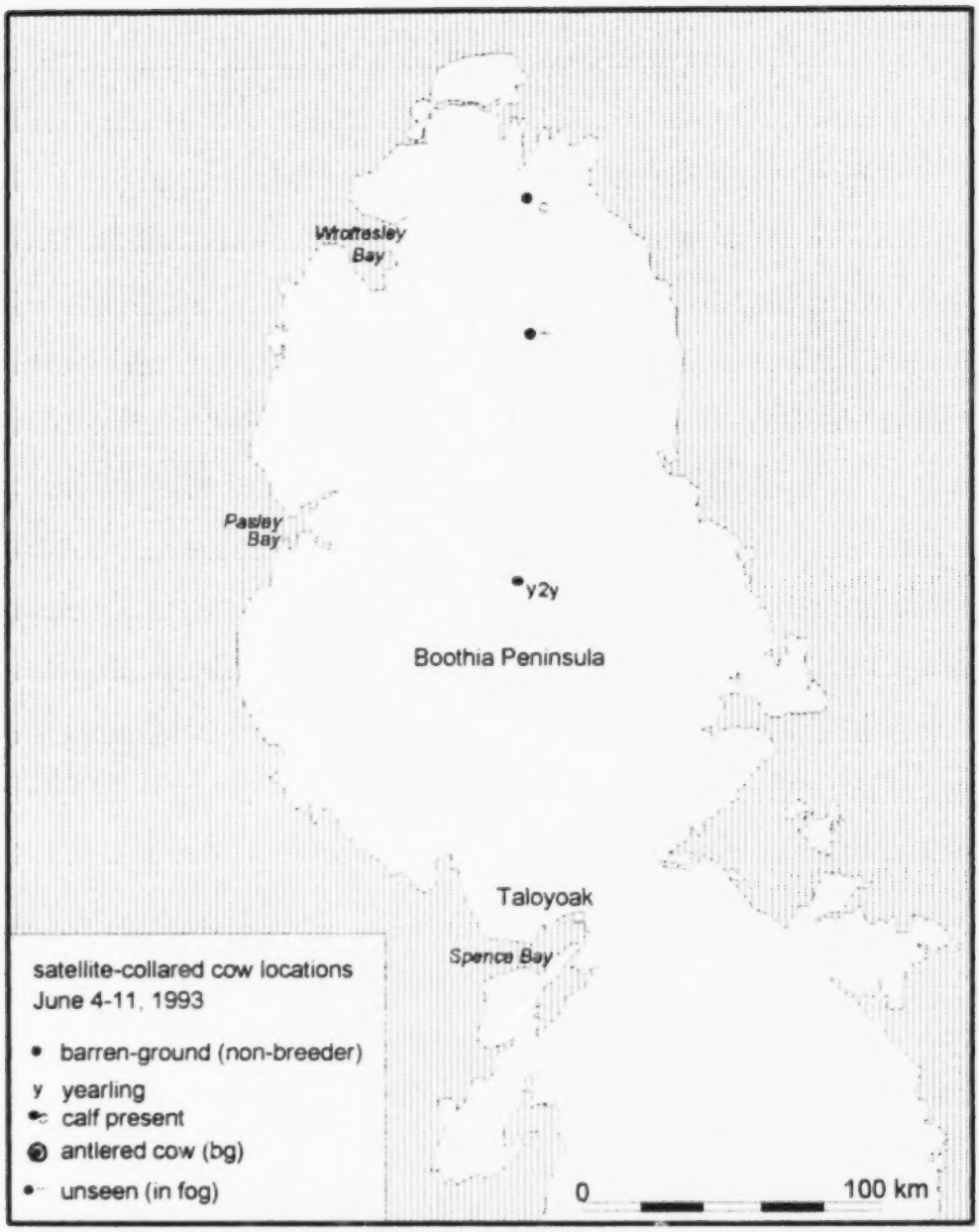

Figure 23. Satellite-collared cow locations on Boothia Peninsula, June 4-11, 1993, Gunn and Fournier in prep.

5. Simpson Lake

Calving ground identification: The identification of a calving ground was based on observations of calving during an aerial survey in 1985 and delineation of calving during an aerial survey in 1989 (Figure 24), and the fact that the two areas overlapped. We have no subsequent information, and the seasonal range of this herd and its relationship with neighbouring herds (Arrowsmith Lowlands, Simpson Peninsula) are unknown. In 1985, Inuit from Pelly Bay had identified that the hills west of Pelly Bay were used for calving.

Landscape and ecology: hilly and characterized by herbaceous vegetation and bare ground tundra.

5. a) Pre-calving surveys (May to early June)

1983 May 4-11 **Heard *et al.* 1987**

This was an extensive low coverage systematic transect survey designed to estimate abundance and distribution over the northeast mainland. The survey was conducted during pre-calving when caribou were approaching their calving grounds. Weather was often better in May than in June and the snow background allowed for ease in tracking. The Simpson Lake area was part of one survey block. The report contains a map of caribou densities and distribution but no flight lines or caribou sightings along those lines (Figure 10).

1995 May 19-23 **Buckland *et al.* in prep.**

The 1983 survey was repeated in 1995 to obtain comparable estimates. Caribou numbers had increased and caribou were distributed relatively evenly across the survey block (Figure 11).

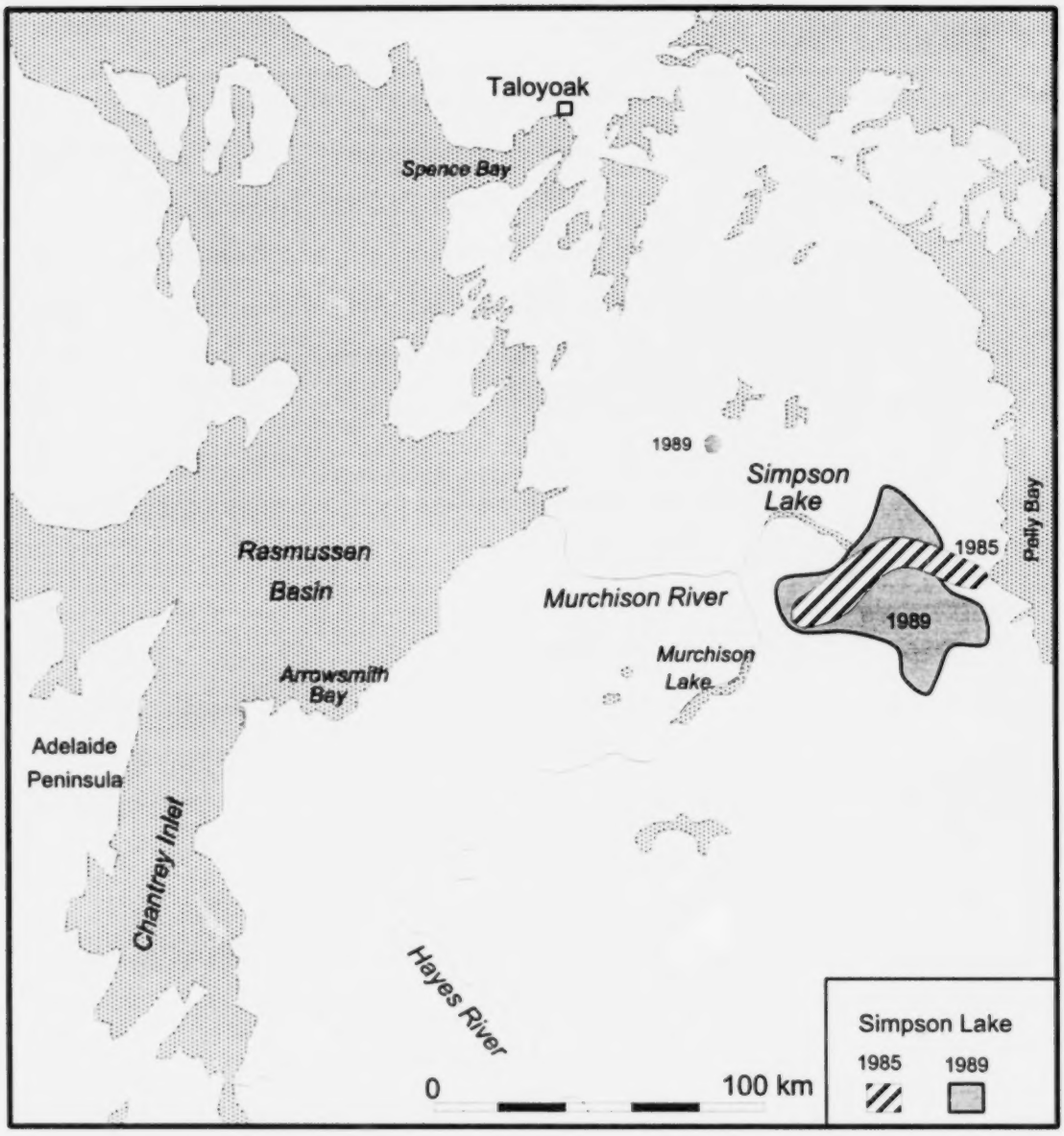

Figure 24. Simpson Lake cow-calf pair locations, 1985 and 1989.

5. b) Calving areas (early to mid- June, newborn calves seen)

1985 June 7- 9 **Gunn and Ashevak 1990**

The systematic strip transect survey was designed to determine caribou abundance and distribution, especially calving distribution. On 9 June 1985, only a few caribou including three cow-calf pairs were seen east of the hills (Figure 13). Caribou numbers were too low to delineate a boundary.

1989 June 9-12 **Gunn and Fournier in prep. a.**

The objective of the systematic transect survey was to determine if calving had resumed in the historic areas identified by hunters in Pelly Bay. The calving ground lay between the west coast of Pelly Bay and Simpson and Murchison lakes to the west (Figure 15). Cows with newborn calves were scattered in the uplands where tussock meadows were interspersed with rock outcrops and still mostly snow-covered. The presence of cows with hard antlers indicated that calving was still happening. The transects extended beyond the calving distribution except for two cow-calf groups seen during a ferry flight between the western ends of two transects (Figure 15). One cow-calf group northwest of Simpson Lake may have been travelling toward Arrowsmith Lowlands as there were northeast-southwest trails in the snow.

5. c) Post-calving surveys (late June/early July): none.

6. Keith Bay

Calving ground identification: The calving ground at Keith Bay was first identified when one satellite-collared cow calved near Keith Bay in 1991 and 1992 (Figure 25) and other cows with calves were seen in the vicinity in 1991 (Figure 26). In 1985, Inuit from Pelly Bay did not identify Keith Bay as a calving area and we did not find any historic information. The 1983 and 1993 pre-

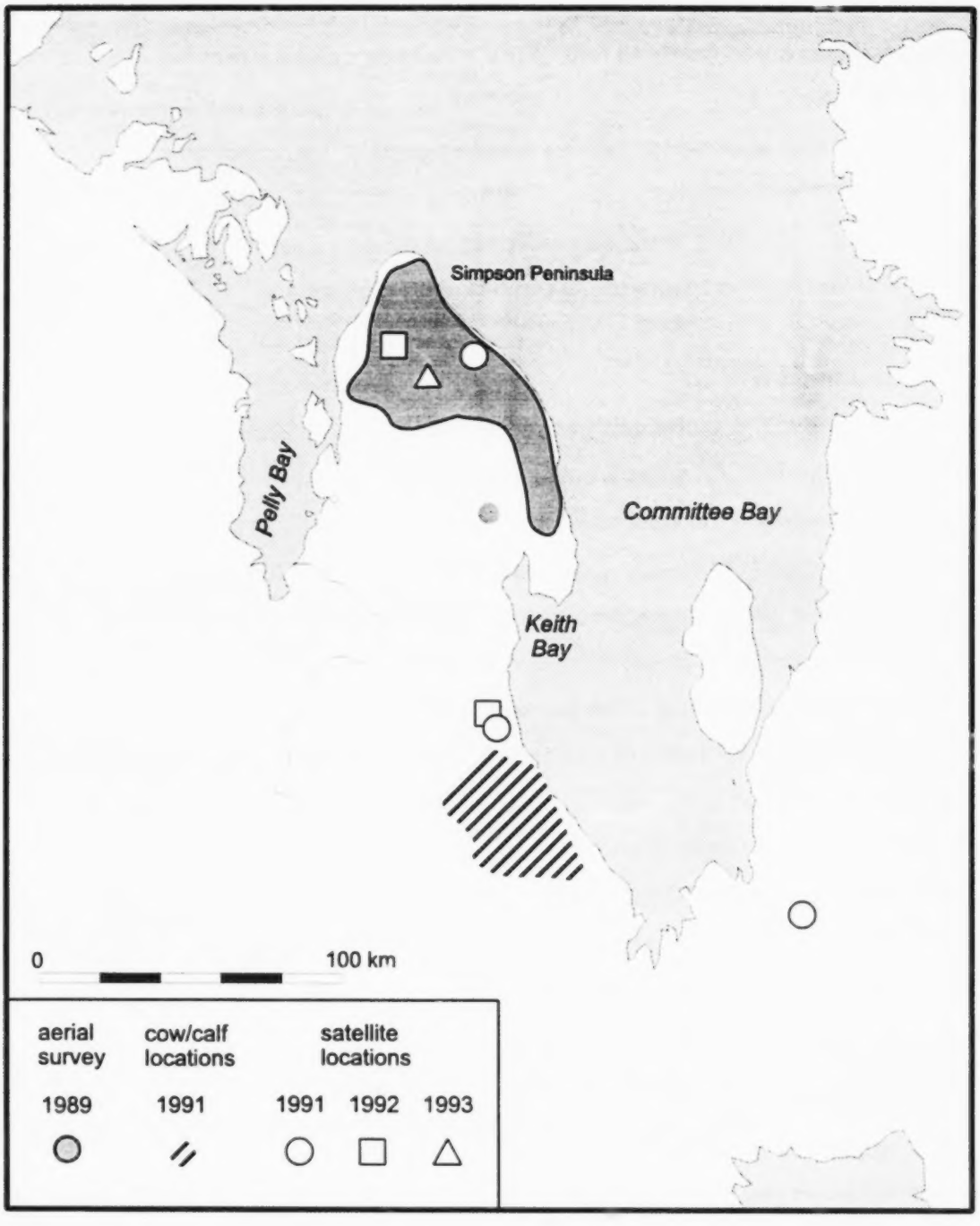

Figure 25. Simpson Peninsula and Keith Bay cow-calf locations, 1989-1993.

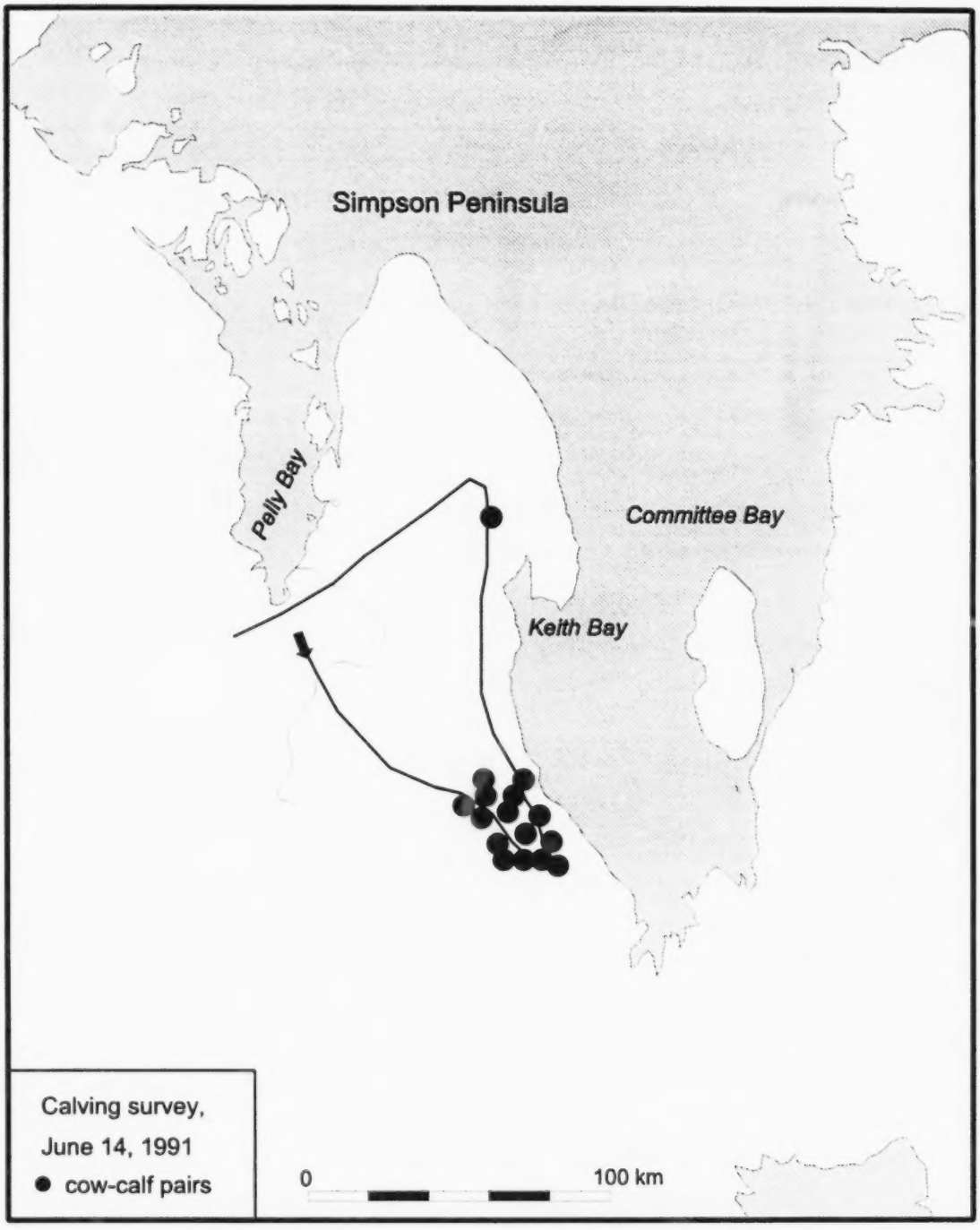

Figure 26. Simpson Peninsula and Keith Bay survey area, June 14, 1991, Gunn and Fournier in prep.

calving surveys suggest that the caribou numbers in the area increased.

Landscape and ecology: coastal lowlands of herbaceous vegetation and bare ground tundra.

6. a) Pre-calving surveys (May to early June)

1983 May 4-11 **Heard *et al.* 1987**

This was an extensive low coverage systematic transect survey designed to estimate abundance and distribution over the northeast mainland. The area was not covered during the extensive aerial surveys that were part of the environmental assessment for the Polar Gas project (Fischer *et al.* 1977). The Keith Bay area was part of one survey block (Figure 10). Survey maps showed no caribou at Keith Bay in May 1983. The report contains a map of caribou densities and distribution but no flight lines or caribou sightings along those lines.

1995 May 19-23 **Buckland *et al.* in prep.**

The 1983 survey was repeated in 1995 to obtain comparable estimates. Caribou numbers had increased and caribou were distributed relatively evenly across the survey block including relatively high densities recorded at Keith Bay (Figure 11).

6. b) Calving areas (early to mid- June, newborn calves seen)

1991-93 June **Gunn and Fournier in prep. a.**

On 14 June 1991, we used conventional (VHF) tracking to locate a collared cow at Keith Bay (Figure 27), but we were unable to visually check to determine her calving status. During that flight on 14 June 1991, we counted about 70 cows with calves although the area was blanketed in fog (Figure 26). We had the impression of high densities from groups of 20-30 cows and calves on the extensive snowfree tussock meadows with rock outcrops. On 19 June 1992, the

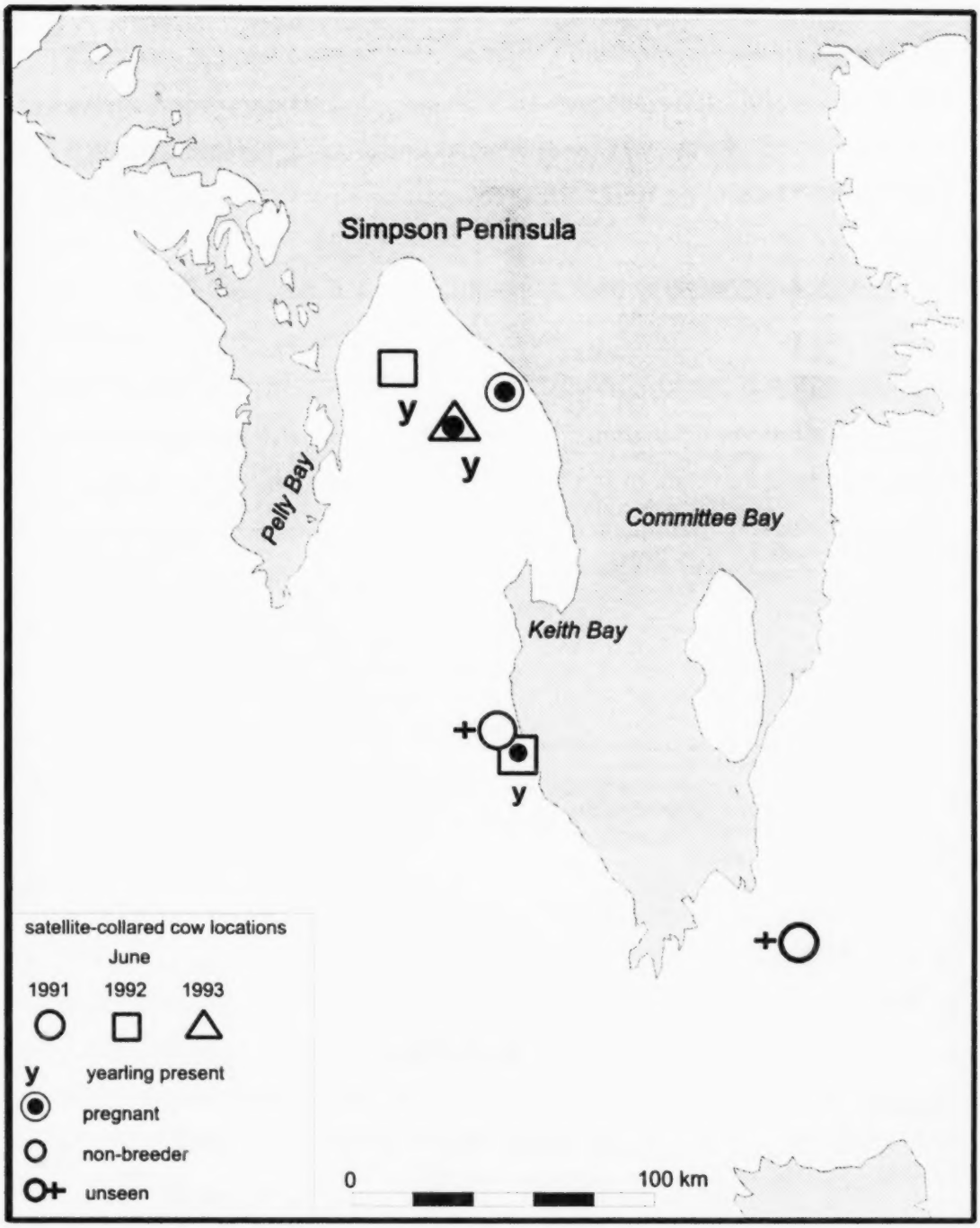

Figure 27. Satellite-collared cow locations in the Simpson Peninsula and Keith Bay area June, 1991-93, Gunn and Fournier in prep.

cow was at a similar location and a yearling accompanied her, but she was antlerless suggesting that she had not been pregnant. There were 'many' cows and calves in her vicinity but they were not counted during the relocation flight. This cow died before the 1993 calving season.

6. c) Post-calving surveys (late June/early July): none.

7. Simpson Peninsula

Calving ground identification: The identification of a calving ground was based on a systematic aerial survey in 1989, which delineated a low density calving ground, and information on calving locations of one satellite-collared cow in 1991, 1992 and 1993 (Figure 25). The collared cow calved within the area that had been delineated in 1989. In 1985, Inuit from Pelly Bay indicated that the Simpson Peninsula had been a calving area before the caribou disappeared (by the 1950s).

Landscape and ecology: coastal lowlands of sparsely vegetated herbaceous and bare ground tundra.

7. a) Pre-calving surveys (May to early June)

1983 May 4-11 **Heard *et al.* 1987**

This was an extensive low-coverage systematic transect survey designed to estimate abundance and distribution over the northeast mainland. The area was not covered during the extensive aerial surveys that were part of the environmental assessment for the Polar Gas project (Fischer *et al.* 1977, Fischer and Duncan 1976). The Simpson Peninsula area was part of one survey block. The report contains a map of caribou densities and distribution but not flight lines or caribou sightings along those lines (Figure 10).

1991 May **Gunn and Fournier in prep.a**

The pre-calving movements of one collared cow were tracked by satellite, but in July 1991, the satellite transmitter failed and her subsequent monthly locations were unknown.

1995 May 19-23 **Buckland *et al.* in prep.**

The 1983 survey was repeated in 1995 to obtain comparable estimates. Caribou numbers had increased and caribou were distributed relatively evenly across the survey block (Figure 11).

7. b) Calving areas (early to mid- June, newborn calves seen)

1989 June 10 **Gunn and Fournier in prep.a**

The systematic transect survey's objective was to determine if calving had resumed in the historic areas identified by hunters in Pelly Bay. On 10 June 1989, snowcover was almost complete and only the beach ridge crests were bare. The presence of cows with hard antlers indicated that calving was still happening. The calving cows were scattered along the coast. One transect extended south of the calving distribution which suggested that the calving distribution was delineated (Figure 28).

1991-93 June **Gunn and Fournier in prep.a**

During a flight in June 1991 to visually check a satellite-collared cow on the northeast Simpson Peninsula, we only counted one other, a cow with hard antlers, in the immediate vicinity of the collared cow but the area was blanketed in fog. On 19 June 1992, we used conventional (VHF) tracking to locate the collared cow on the peninsula's west coast. She had no antlers and was accompanied by a yearling. In 1993, the cow was pregnant when she was collected on 8 June 1993 at a location similar to where she calved in 1991 (Figure 27).

Figure 28. Simpson Peninsula survey area, June 9-12, 1989, Gunn and Fournier in prep.

7. c) Post-calving surveys (late June/early July): none.

8. Wager Bay

Calving ground identification: The identification of a calving ground was based on two surveys which reported a delineated calving distribution in 1976 and 1977 and 3 years of presumed calving cow locations mapped from radio-tracking 1986-88 (Figure 29). During the study of calving ground fidelity between 1986 and 1988, radio-tracking determined the locations of radio-collared cows but calving status was not visually confirmed. The distribution from aerial surveys in 1974 and 1977 partially overlaps and abuts the overlapping distribution of the radio-collared cows 1986-88.

Landscape and ecology: highlands and hills with rocky plains and herbaceous tundra vegetation.

8. a) Pre-calving surveys

1983 May 4-11 **Heard *et al.* 1987**

The authors flew this survey to determine pre-calving distribution and abundance of caribou on the northeast mainland. Two concentrations of caribou were found close to known Wager herd calving grounds - one was on the north coast of Wager Bay and the second was at the base of Committee Bay (Figure 30).

1995 May 19-23 **Buckland *et al.* in prep.**

Pre-calving distribution and population estimates were determined from this survey which used the same stratification and methods as Heard *et al.* (1987). Relatively few caribou were scattered along the north shore of Wager Bay (Figure 31) and the estimated numbers had declined since 1983.

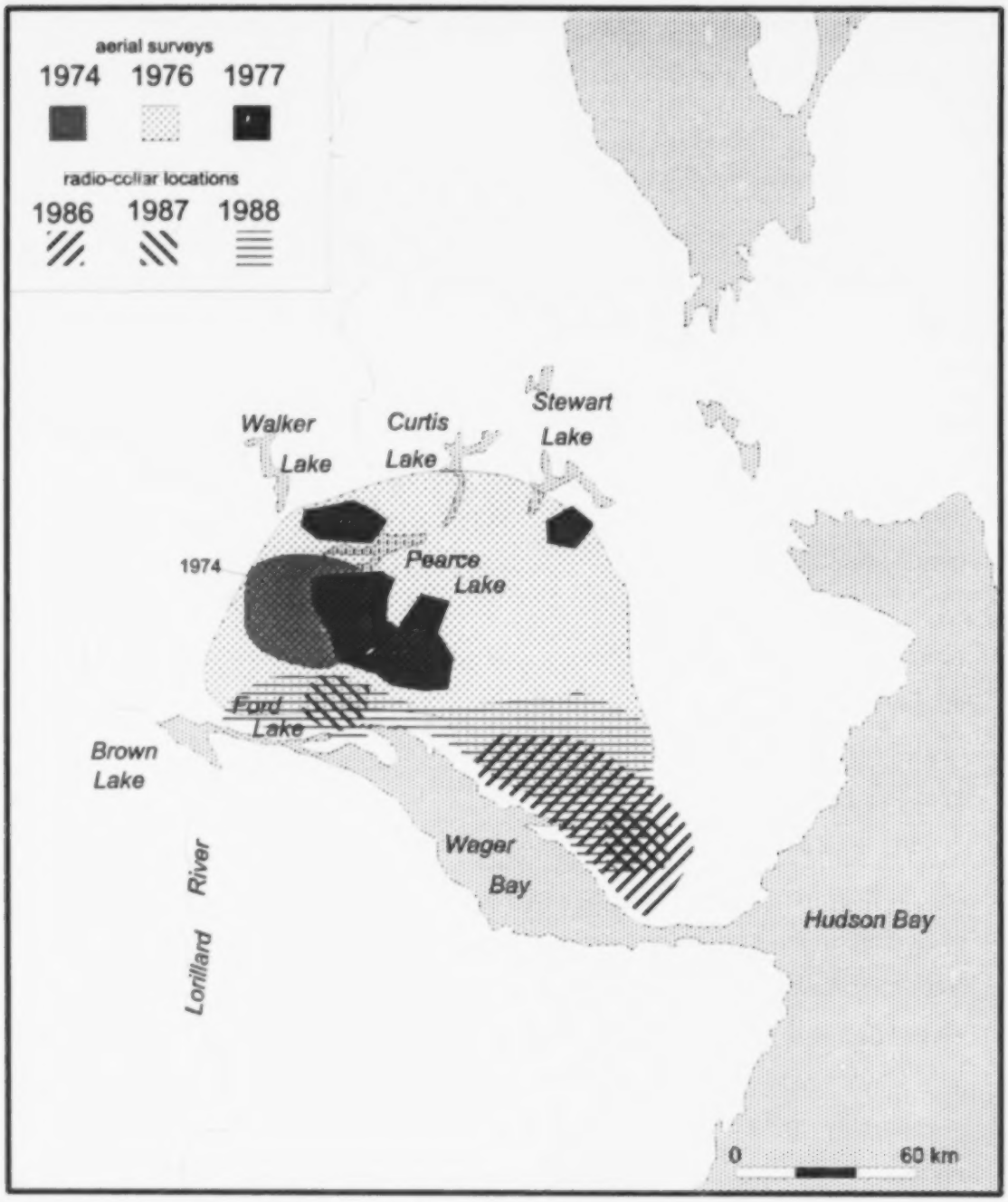

Figure 29. Wager Bay cow-calf locations, 1974-1988.

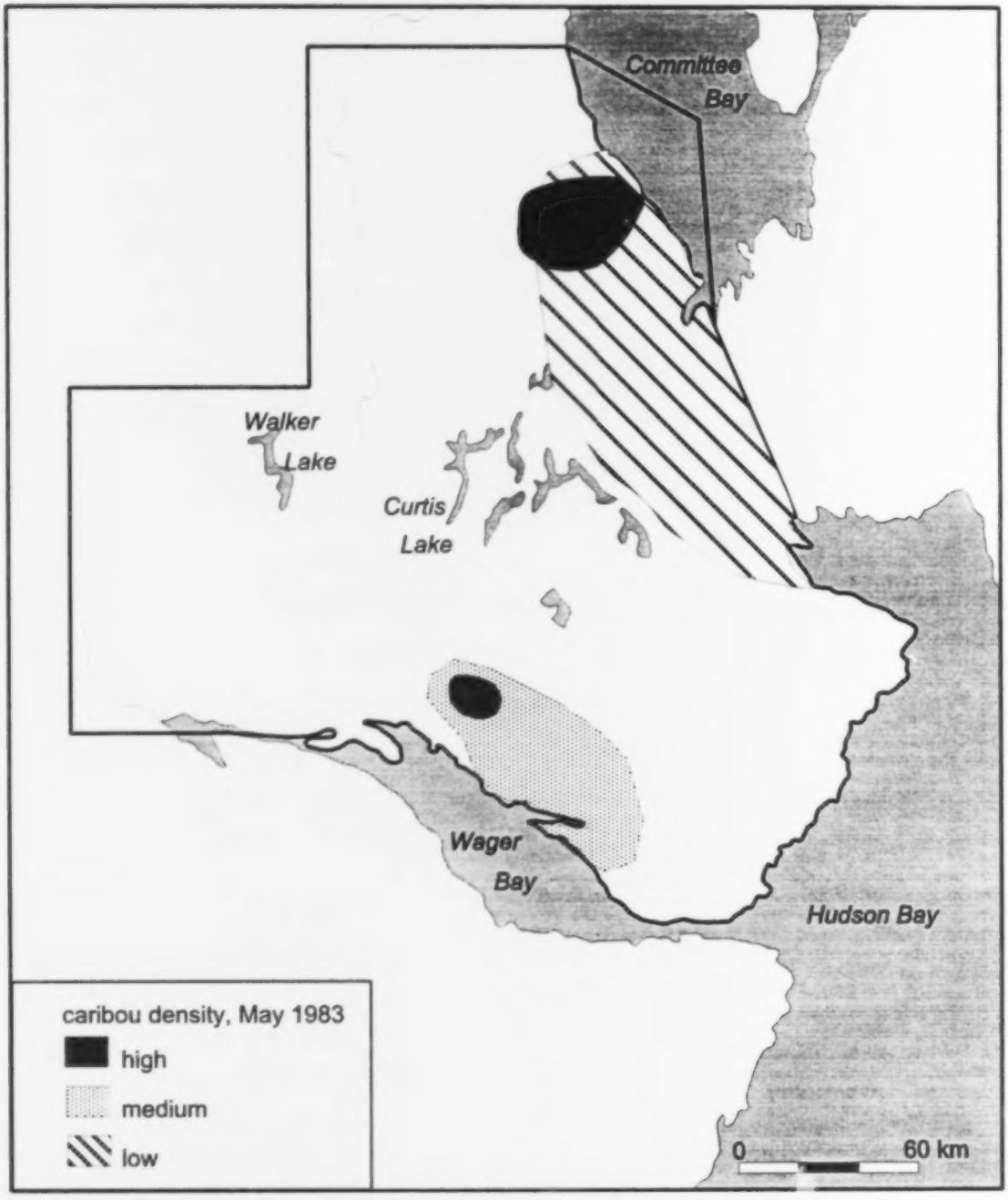

Figure 30. Wager Bay survey area, May 4-11, 1983, Heard *et al.* 1987.

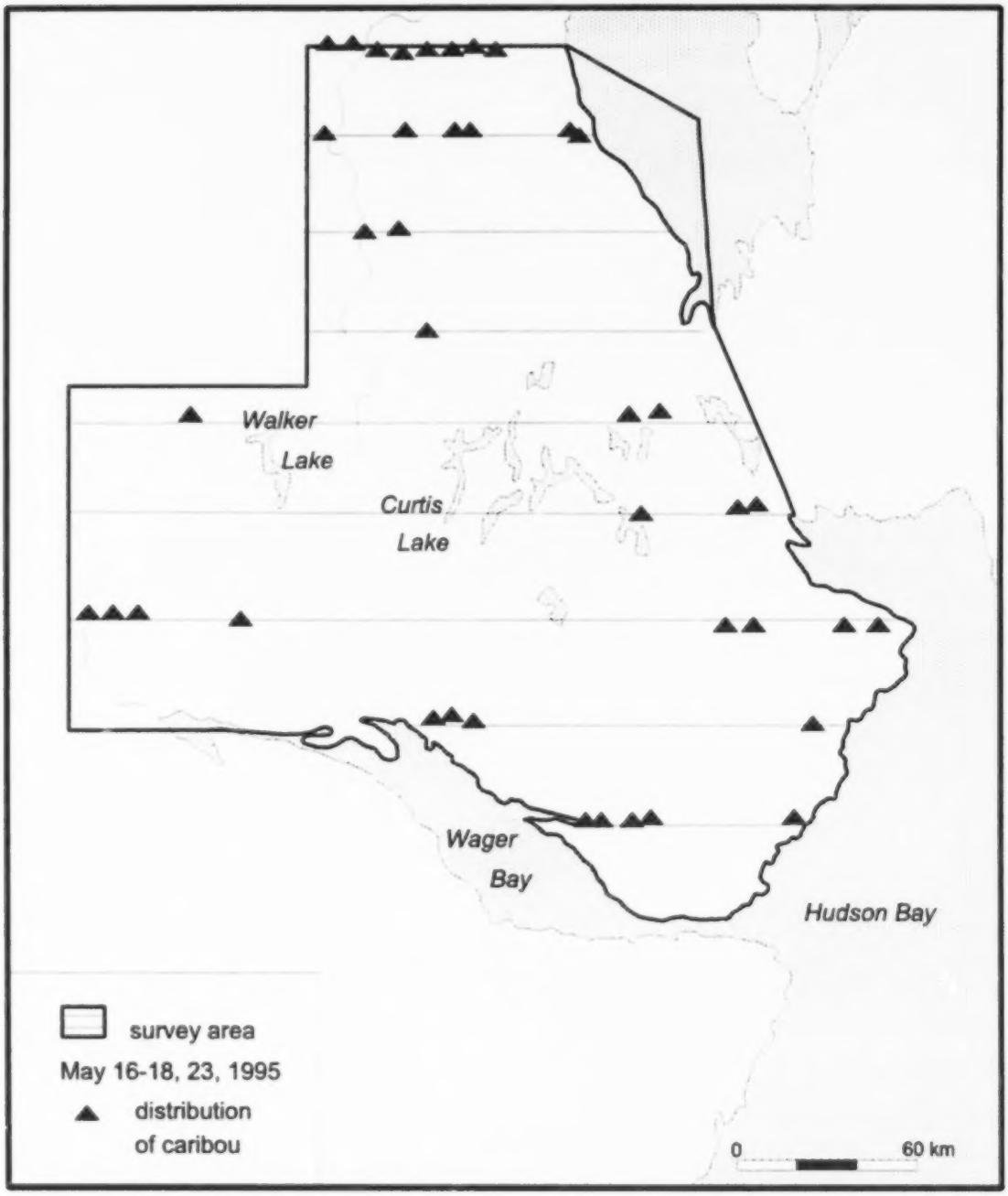

Figure 31. Wager Bay survey area, May 16-23, 1995, Buckland *et al.* in prep.

8. b) Calving areas (early to mid- June, newborn calves seen)

1973 **Pendergast and Bowden 1973**

Bowden and Helmer (1974b) refer to incidental observations of calving west of Repulse Bay in the vicinity of Pearce and Curtis lakes but the original report is not available.

1974 June 2-5 **Bowden and Helmer 1974b**

The survey was designed to record pre-calving migration, delineate major calving areas and estimate caribou numbers on the calving areas (Figure 32). The reconnaissance flights on May 28 and 29 found cows and yearlings west of Repulse Bay (Pearce Lake). The report does not detail how the calving ground was delineated but the concentration was surveyed twice between 2 and 5 June. The report suggests that the Pearce Lake calving ground extended further west, although no evidence was given for this and sightings are not clearly visible on the original study map. The authors also recorded caribou cows with calves on 6 June immediately north of Wager Bay to suggest isolated calving or the possible existence of another calving area. Reconnaissance flights in the hills north of Curtis, Stewart and Walker lakes did not find calving. Original maps do not show clearly marked recorded movements or sightings, but outline the surveyed calving area.

1977 June 12 - 21 **Donaldson 1981**

This survey was a follow-up to the 1976 post-calving survey to determine the population structure and size of the Wager herd in 1977. Reconnaissance flights on June 12 and 13, over the 1976 survey area north of Wager Bay, located two concentrations of calving: the larger area south of Pearce Lake enclosed two areas (Naguak Lake and Pearce Lake) mentioned by Bowden and Helmer (1974b), and a smaller and denser concentration further east was located on the hilly terrain south of a string of lakes draining Stewart Lake. Most calves

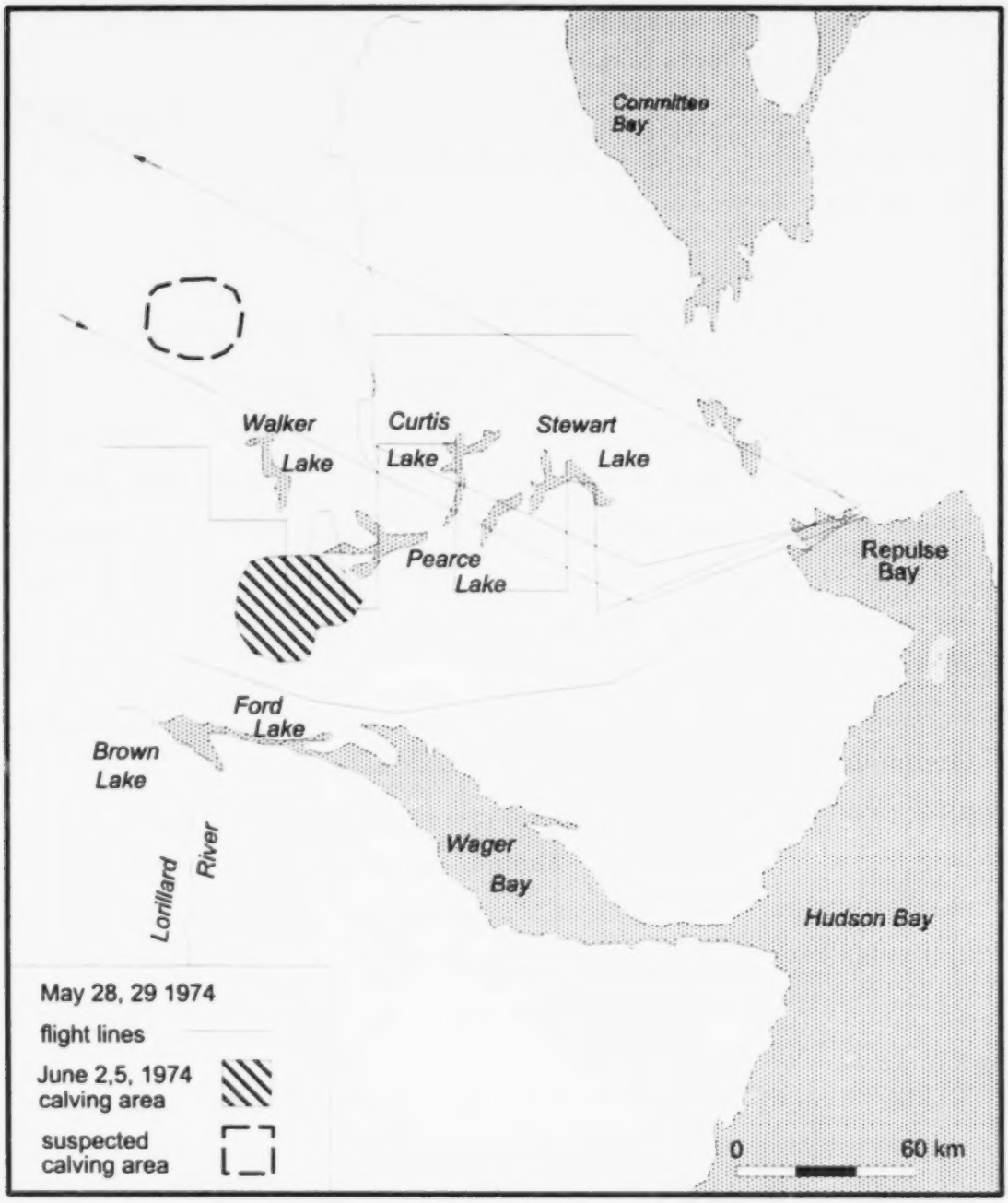

Figure 32. Wager Bay survey area, May 28, 29 and June 2,5 1974, Bowden and Helmer 1974.

seen (86%) were within the two concentrations of calving. The subsequent stratification was based on calf distribution and the area was resurveyed in three strata from 16 to 21 June (Figure 33). The author noted that all calves were seen above 300 m and most above 400 m on the height of the land. Although the transect lines continued past the mapped calving distribution, the criteria for delineating the calving areas were not reported. The 5000 km^2 calving ground, located north of the west end of Wager Bay near Curtis Lake, was described as being characteristically high, rocky and relatively barren. In June 1977, 95% of the calves observed were in this area.

1985-88 June **Heard and Stenhouse 1992**

During an investigation of calving ground fidelity, researchers put radio-collars on caribou cows in the Keewatin district and relocated the cows at calving. In June at Wager Bay, the authors tracked 23 cows in 1985, 1987 and 1988 and 40 in 1986. The report provided few details, such as date of relocation, or data to support assigning the collared cow locations to core and peripheral calving grounds. The report defined core as having "...a continuous distribution of calving cows at relatively high densities". The report also stated that the core calving ground at Wager Bay was "...based on the location of the collared cows and incidental observations of uncollared animals". Between 1985 and 1988, the proportion of cows calving in the peripheral of the calving area annually varied between zero and 13%.

From locations of cows in the Wager Bay area (Figure 34) over the four-year study, the authors concluded that the Wager herd calved at lower densities than Bathurst and Qamanirjuaq caribou, and that the location of high density calving varied more between years. Four of the collared cows changed between recognizable calving grounds: from Wager Bay to Melville Peninsula and from

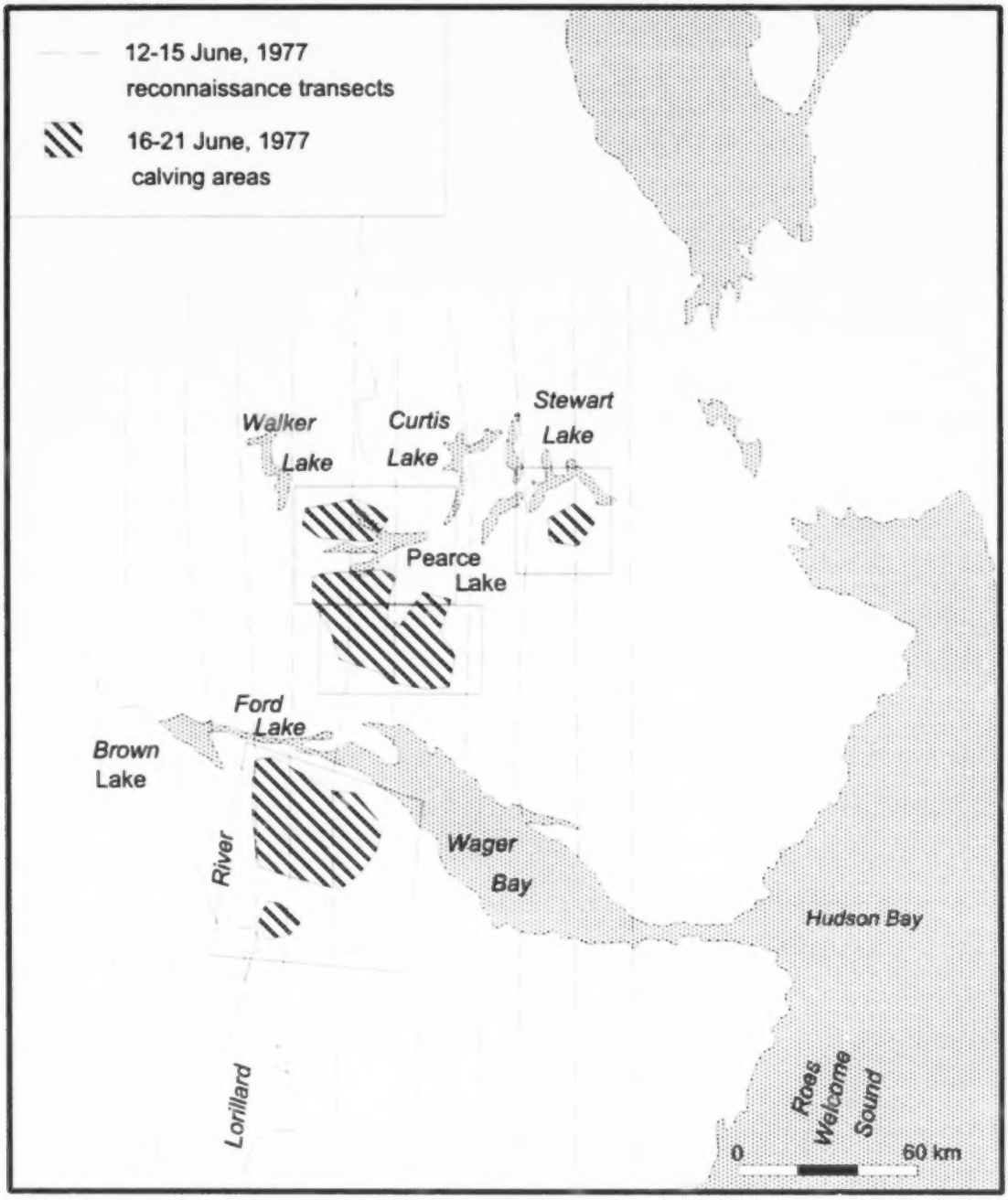

Figure 33. Wager Bay and Lorillard River survey area, June 12-21, 1977, Donaldson 1981.

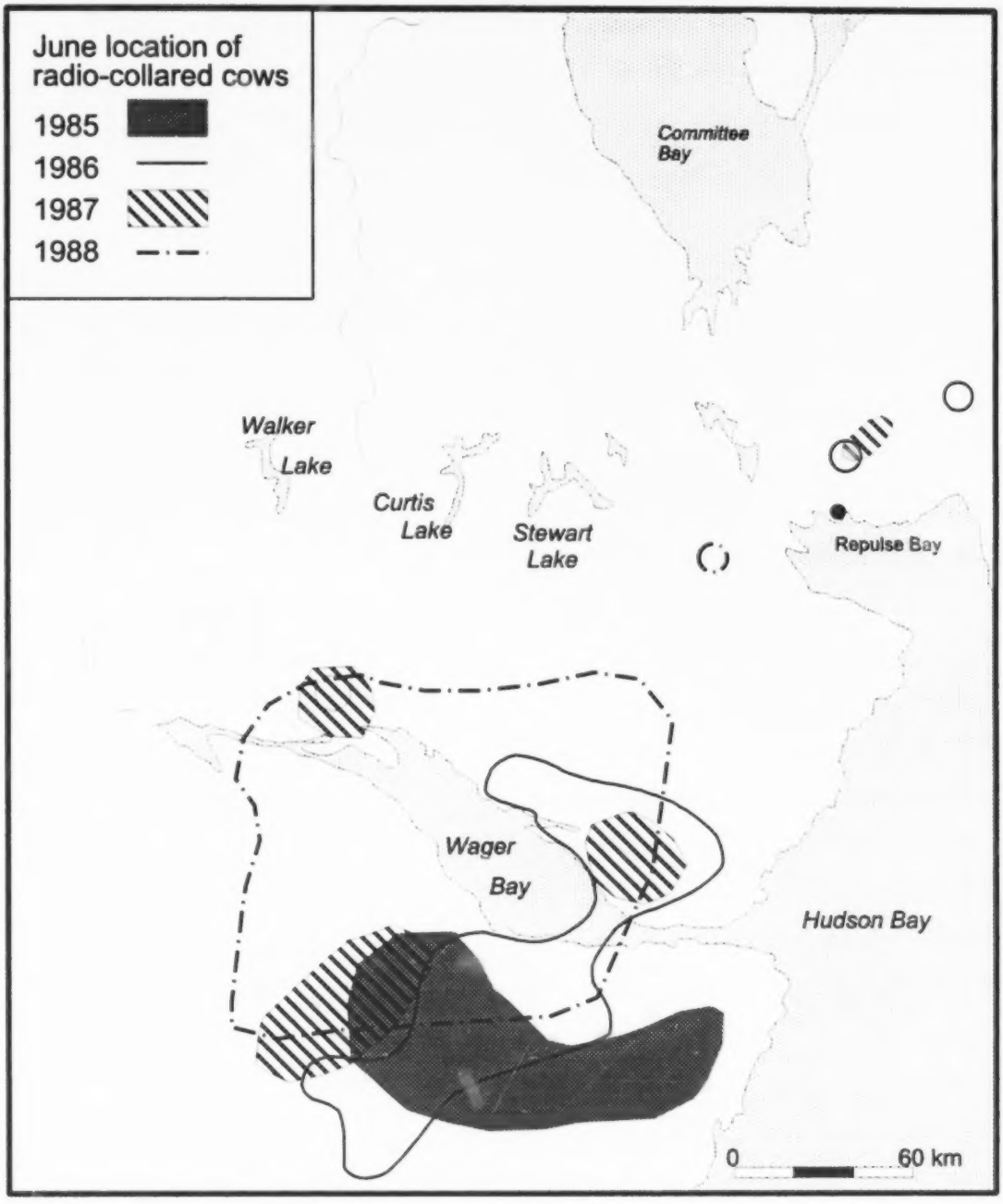

Figure 34. June radio-collared cow locations in the Keewatin District, 1985-88, Heard and Stenhouse 1992.

Melville Peninsula to Wager Bay. Of the cows that calved around Wager Bay, 12 of 34 calved on both sides of the bay, while the remaining 22 stayed on one side or the other. The report's maps show locations in June 1985 to 1988.

The authors concluded that the Wager herd had a different calving strategy from other larger barren-ground caribou herds because of the close proximity of calving and wintering grounds (i.e. no long spring and fall migrations), and being more dispersed at calving. The authors reported that the "calving ground concept suggests Lorillard and Wager Bay must be considered one herd but movements throughout all of the northeastern mainland are still too poorly known to be able to differentiate subpopulation".

8. c) Post-calving surveys

1976 June 29 - July 2 **Heard *et al.* 1981**

After a reconnaissance flight on 29 June 1976, the area was stratified and resurveyed by 2 July. Cows with calves were found throughout the four strata north of Wager Bay. The distribution of bulls and cows with calves overlapped although most bulls were within 16 km of the coast. The authors commented that the mixing of the bulls and cows with calves was the likely consequence of the calving ground being close to the coast. They reported that "...relatively large post-calving concentrations in stratum 4 were moving south down river valleys toward the coast of Wager Bay (Figure 35). Their direction of movement indicated that they had calved further north, presumably on the rocky plains south of Curtis Lake". In their discussion, the authors commented that they did not find a distinct calving ground although it was possible that the cows had calved around Curtis Lake and dispersed as calving had occurred two weeks before (no details or support for this date of calving are in the report).

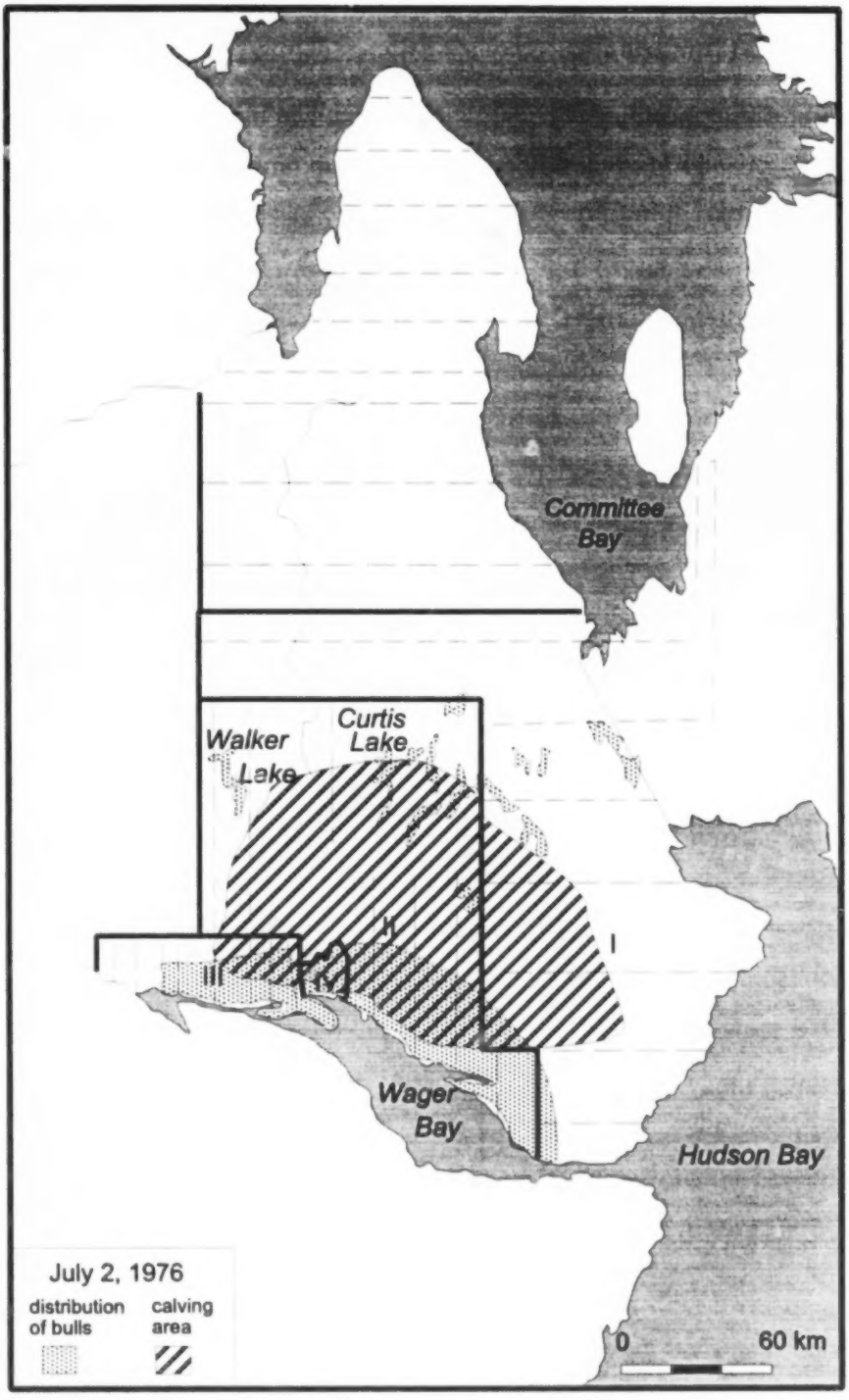

Figure 35. Wager Bay survey area, July 2, 1976, Heard *et al.* 1981.

9. Lorillard River

Calving ground identification: The identification of a calving ground was based on two surveys which reported a delineated calving distribution in 1974 and 1977 and four years of presumed calving cow locations mapped from radio-tracking in 1985-88 (Figure 36). During the study of calving ground fidelity between 1985 and 1988, radio-tracking determined the locations of radio-collared cows but calving status was not visually confirmed. The distribution from aerial surveys in 1976 and 1977 overlapped with the distribution of the radio-collared cows in 1985-88.

Landscape and ecology: highlands and hills with rocky plains and herbaceous tundra with shrub and brush.

9. a) Pre-calving surveys

1983 May 4-11 **Heard *et al.* 1987**

The authors flew this survey to determine pre-calving distribution and abundance of caribou on the northeast mainland. Two caribou concentrations were relatively close to and south of the calving grounds (Figure 37). The report also cited unpublished (and unavailable) information that the area was surveyed in 'spring' 1979 and 1980.

1995 May 19-23 **Buckland *et al.* in prep.**

Population estimates were determined from this survey which used the same stratification as Heard *et al.* (1987).

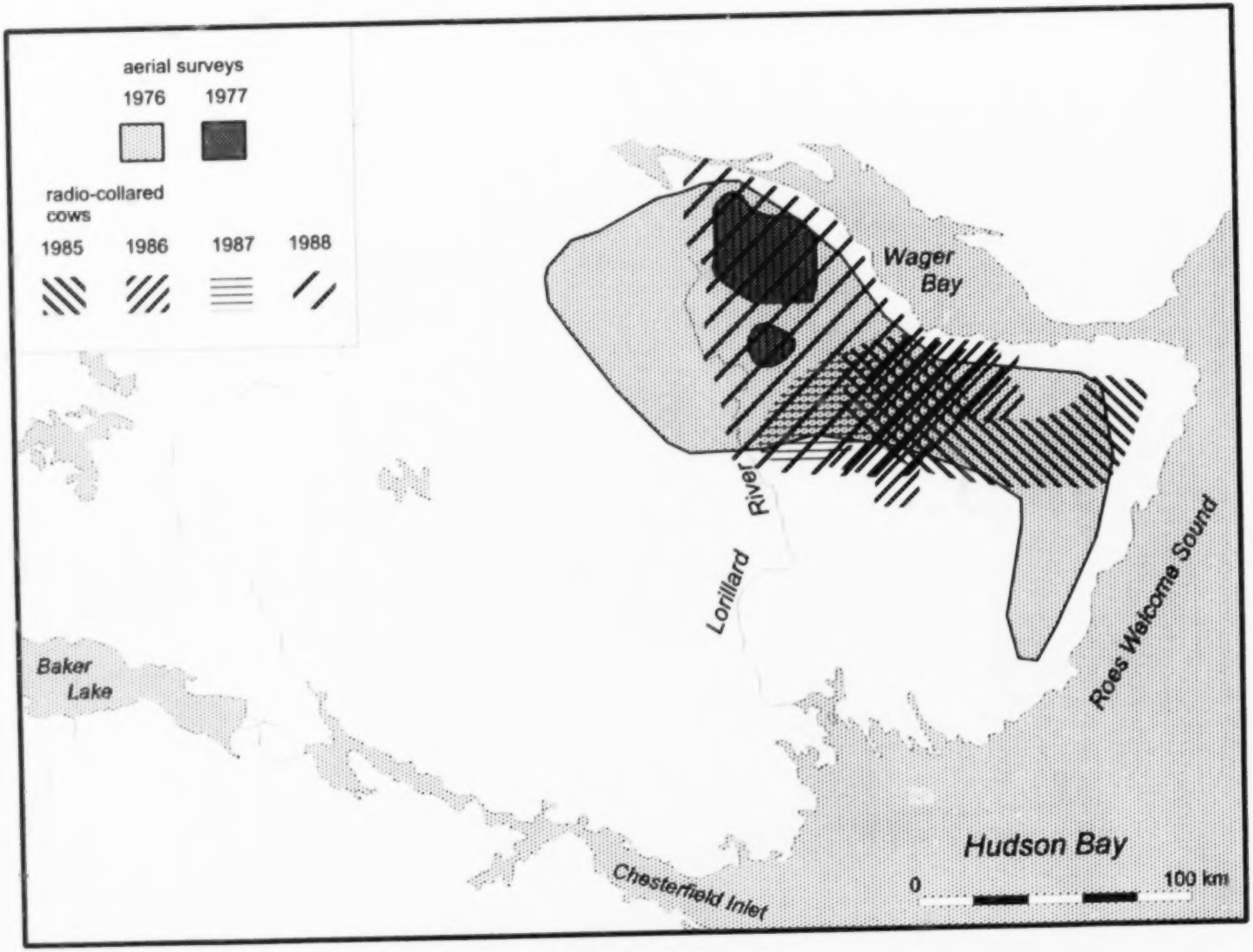

Figure 36. Lorillard River cow-calf locations, 1976-1988.

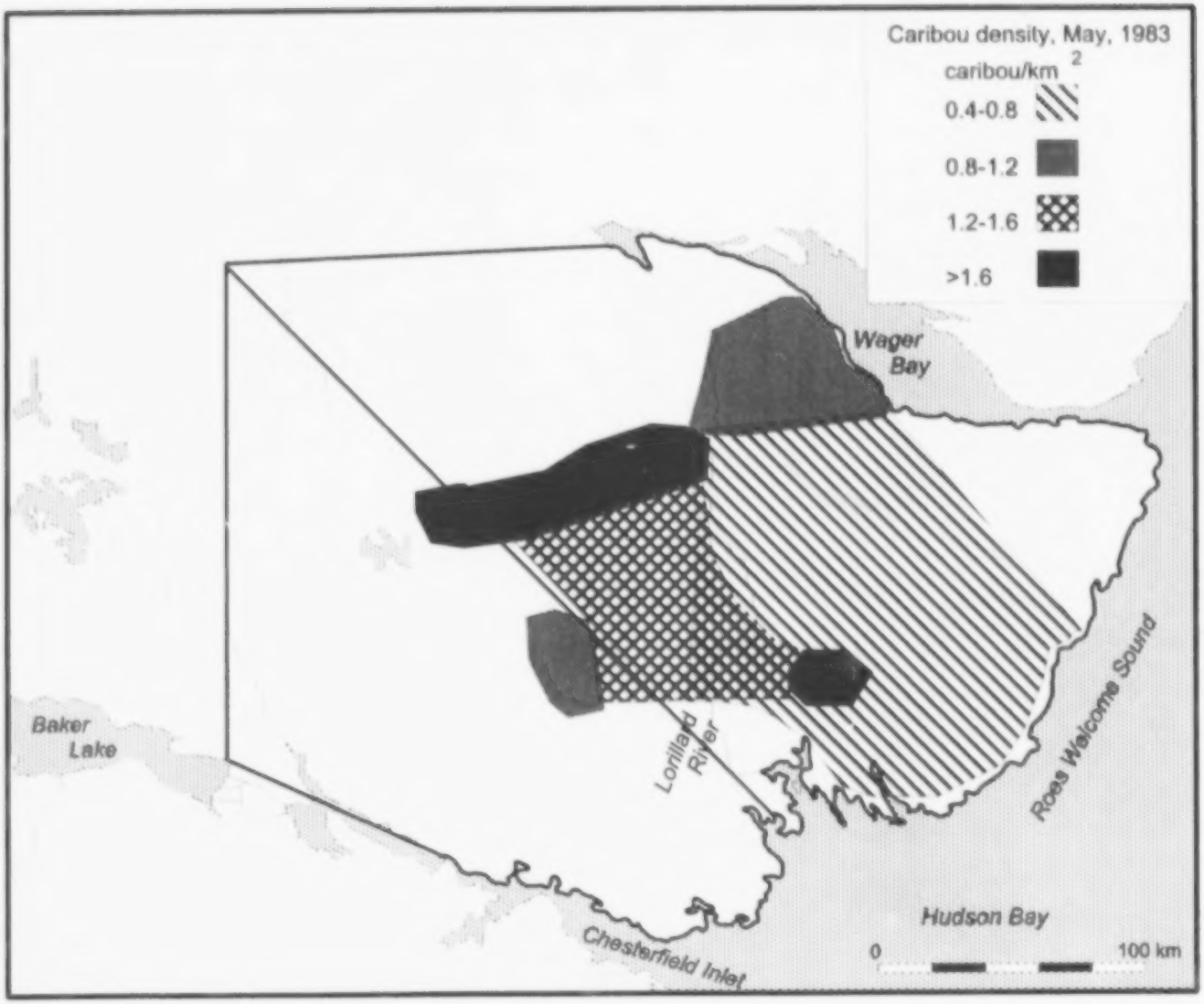

Figure 37. Lorillard River survey area, May 4-11, 1983, Heard *et al.* 1987.

9. b) Calving areas (early to mid- June, newborn calves seen)

1976 June 15-25 **Heard *et al.* 1981**

The aerial survey was to determine population size and distribution. Between 15 and 25 June, transects at 16-km intervals evenly covered the area south of Wager Bay (no stratification). The criteria for defining the calving ground were unreported but it was delimited as a 12 000 km^2 area of highlands (Figure 38) 250 - 500m above sea level at the headwaters of the Lorillard River south of Wager Bay. Most (80%) of the 370 calves seen were in this area and the caribou density (excluding calves) was four times higher on the calving ground than in the rest of the survey area. The report did not comment on whether the calves were newborn, or on whether post-calving movements were underway. The report's map of transects and caribou observations did not distinguish between calves and other caribou.

1977 June 4-15 **Donaldson 1981**

The aerial survey was to determine population structure and size for the Lorillard herd in June 1977. The reconnaissance flights were on 4- 5 June and 10-13 June and an area of higher calf density was resurveyed on 14-15 June (92% of the calves seen were contained within the delineated calving ground). The caribou were calving on the "high rolling hills south of Wager Bay and Ford Lake". The report noted that the 1977 calving ground was smaller than and within the boundaries of the calving area delineated in 1976 (Figures 33 and 36), although the 1977 area was surveyed later when post-calving movements may have started. The report's calving map shows two calving areas, but the map of transects does not have caribou observations.

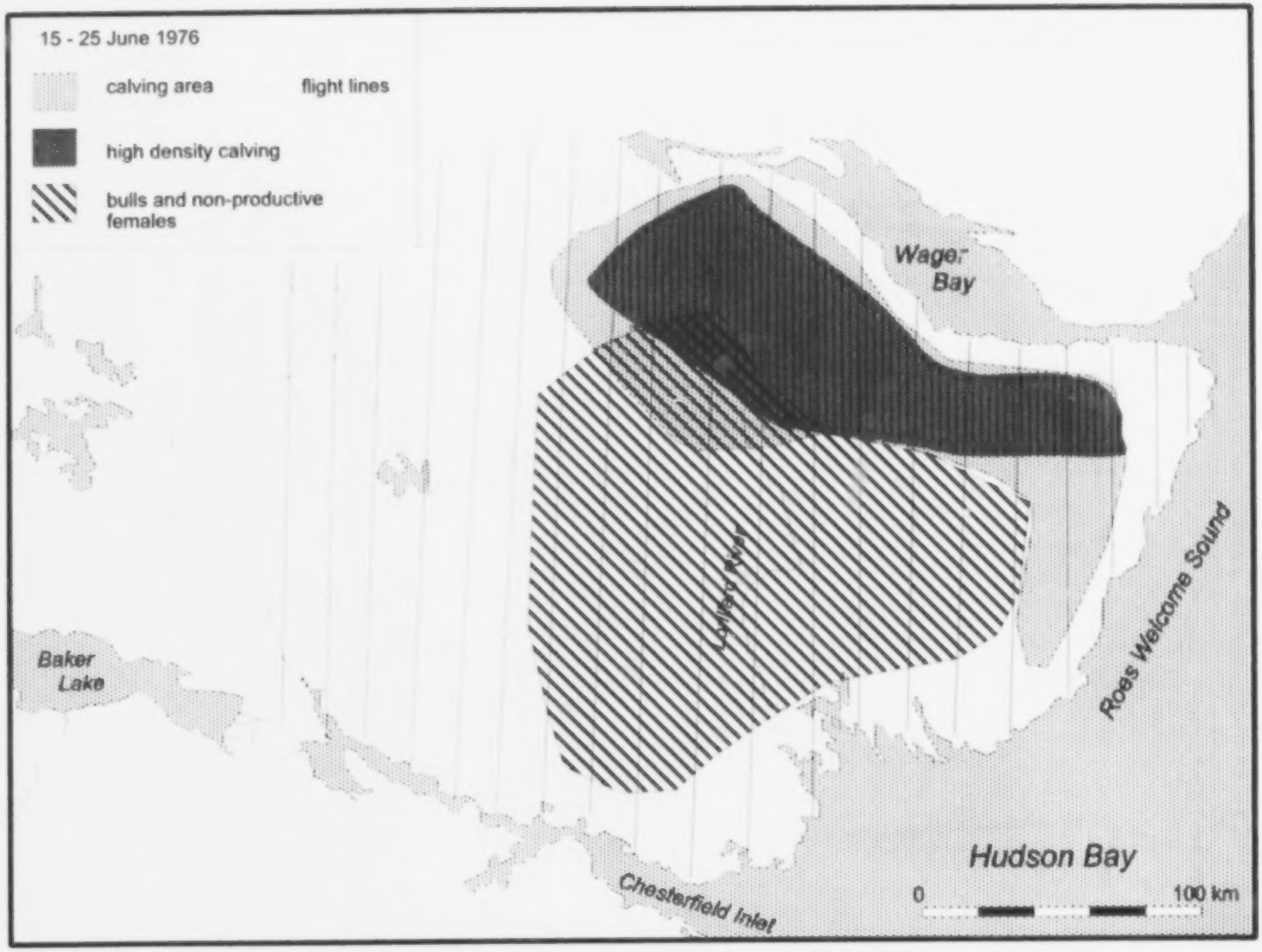

Figure 38. Lorillard River survey area, June 15-25, 1976, Heard *et al.* 1981.

1985-88 June **Heard and Stenhouse 1992**

During an investigation of calving ground fidelity, researchers put radio-collars on caribou cows in the Keewatin district and relocated them at calving. In June at Wager Bay, the authors tracked 23 cows in 1985, 1987 and 1988, and 40 in 1986. The report provided few details, such as date of relocation or annual data to determine where cows calved. In May 1985, 22 radio collars were put on caribou captured near the Lorillard River. Twenty-one caribou were located south of Wager Bay (area delimited as Lorillard calving ground in Calef and Heard (1980)) and two were located in the 'Wager peripheral' in June 1985. In 1986, 34 radio-collared cows were located around Wager Bay on the north and south shores (report did not give a breakdown). In 1987, seven of the cows were located in the Lorillard calving area in June. During the final year of the study, June 1988, 23 cows were distributed around the shores of Wager Bay. Over the four years, of the cows that calved around Wager Bay, 12 of 34 calved on both sides of the bay, while the remaining 22 stayed on one side or the other. The report's maps showed locations in June 1985 - 1988 (Figure 34).

Most of the author's discussion dealt with calving north of Wager Bay, but the report stated that the "calving ground concept suggests Lorillard and Wager Bay must be considered one herd but movements throughout all of the northeastern mainland are still too poorly known to be able to differentiate subpopulation".

9. c) Post-calving surveys: none.

10. Southern Melville Peninsula

Calving ground identification: The calving ground identification was based on a calving distribution delineated in 1974 which overlapped with an extensive early post-calving distribution delineated in late June 1976 (Figure 39). The locations of three radio-tracked cows from 1986 to 1988 were clustered about 50 km south and did not overlap the 1974-76 distribution. However, in early June 1991, a satellite-collared cow was located on the southern boundary of the area delineated as early post-calving in 1976.

Landscape and ecology: sparsely vegetated herbaceous and bare ground tundra plateau area within highlands.

10. a) Pre-calving surveys

1972 May 20-22 **Rippin and Bowden 1972b**

The authors interviewed hunters about caribou movements on southern Melville Peninsula and conducted a survey to determine caribou distribution and probable calving ground location. Caribou tracks headed toward the interior highlands from the south and east coastal areas and hunters at Repulse Bay reported many caribou moving eastward through Rae Isthmus in April and May. The report discussed a probable calving area northeast of Repulse Bay in the high plateau area (Figure 40). There were reports about caribou wintering along the coast south of Repulse Bay and the authors suggested that these animals may be part of those that calve on Melville Peninsula. The report includes a map of the probable calving area and flight lines.

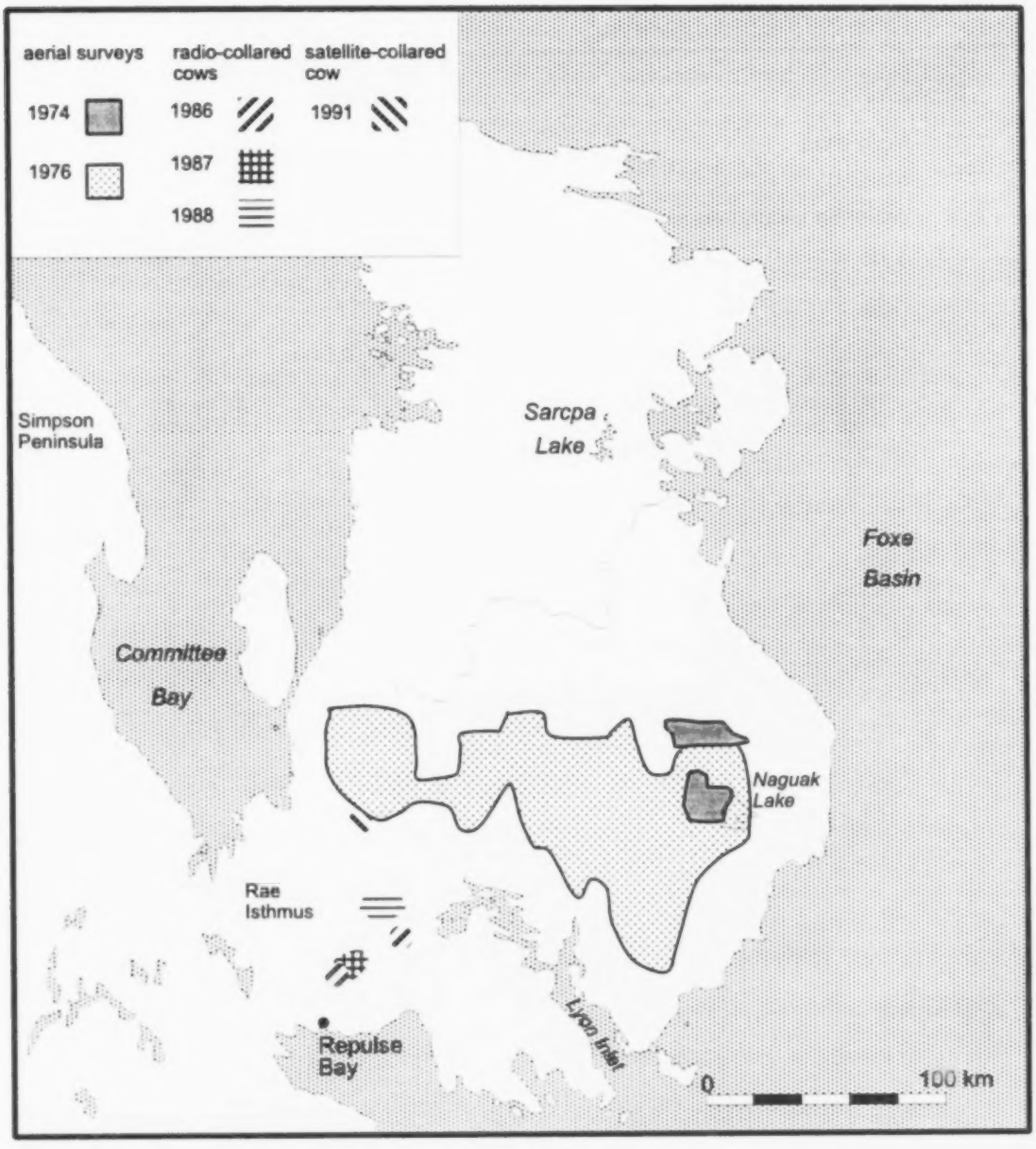

Figure 39. South Melville Peninsula composite surveys.

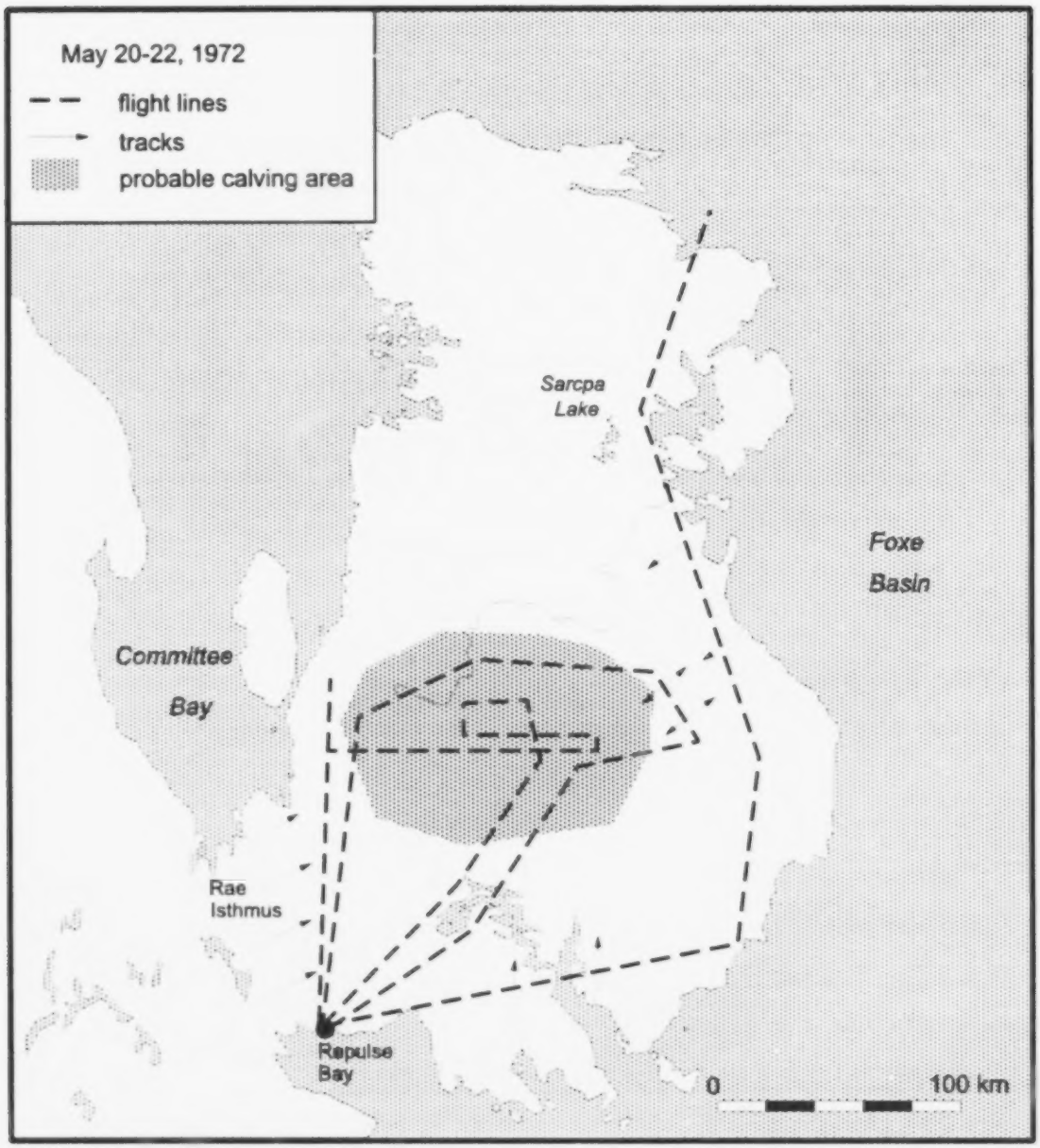

Figure 40. South Melville Peninsula survey area, May 20-22, 1972, Rippen and Bowden, 1972.

1973 **Pendergast and Bowden 1973**

Calef and Heard (1980) refer to a survey of Melville Peninsula in 1973, but the report is unavailable.

1983 May 4-11 **Heard *et al.* 1987**

This survey was to determine pre-calving distribution and abundance of caribou on the northeast mainland including southern Melville Peninsula (Figure 41). Caribou on the east shore of Committee Bay appeared to be moving east into the interior of Melville Peninsula. Residents of Repulse Bay reported caribou moving north in early May and the report described fresh trails oriented north and west of Repulse Bay. Caribou densities were shown on the report's maps and it was noted that concentrations were found close to known calving areas.

1995 May 19-23 **Buckland *et al.* in prep.**

The survey used the same stratification as Heard *et al.* (1987) to estimate population size (Figure 42). These estimates were compared to the 1983 estimates. No discussion was made of distribution although a decline of caribou on Melville Peninsula was noted.

10. b) Calving areas (early to mid- June, newborn calves seen)

1974 June 2- 5 **Bowden and Helmer 1974b**

Caribou were moving when reconnaissance flights began over southern Melville Peninsula (May 29) and the tracks indicated a general movement toward the interior. The reconnaissance flight identified that tracks led toward Naguak Lake where there was a concentration of cows with calves. The Naguak Lake area was resurveyed and two calving grounds were mapped about 10 km apart. The criteria for the delineation were not in the report. The maps did not show clearly recorded movements or sightings but only outlined the surveyed calving areas (Figure 43). During the re-surveys on 2 June 1974, four of 171 caribou

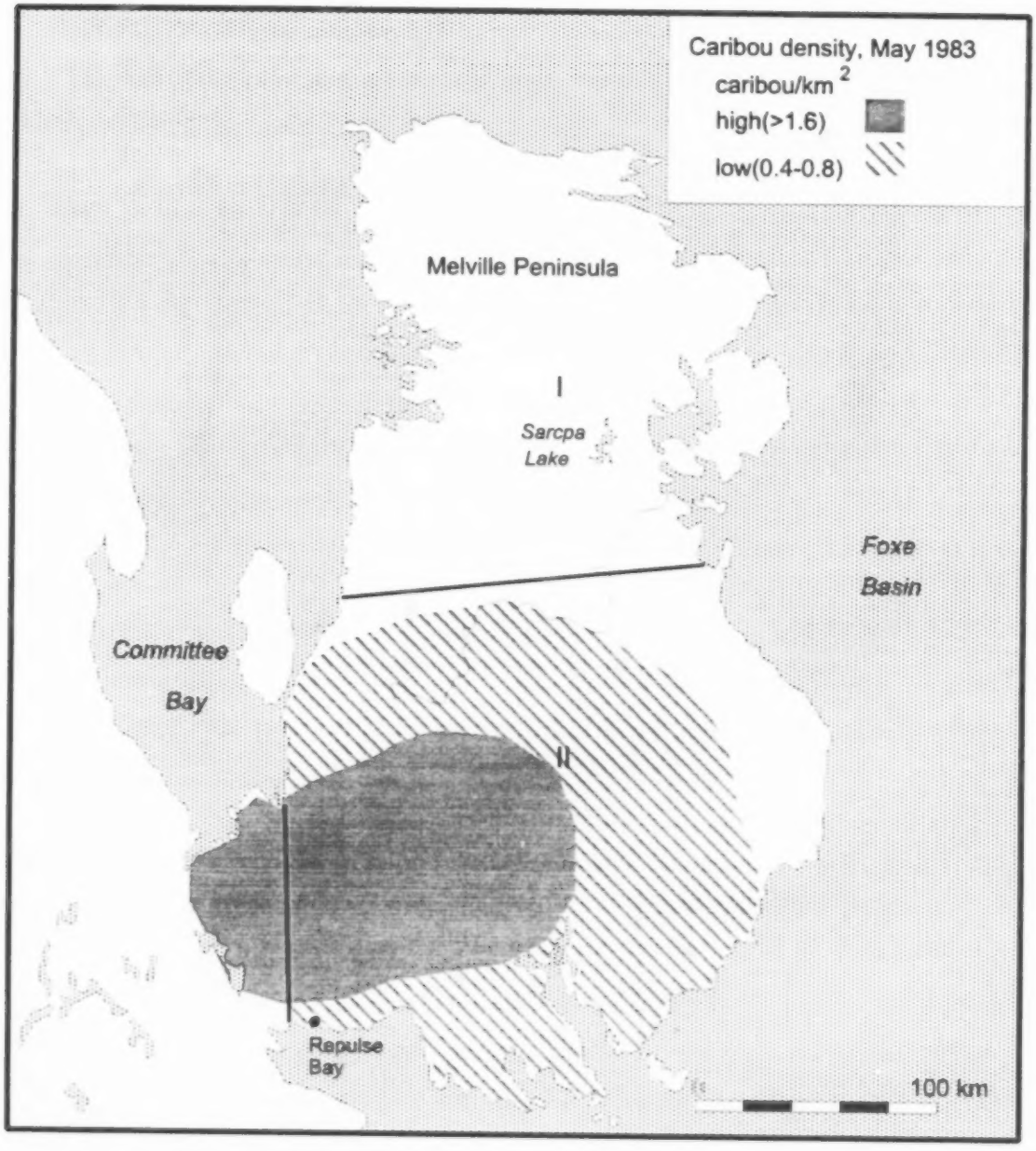

Figure 41. Melville Peninsula survey area, May 4-11, 1983, Heard *et al.*, 1987.

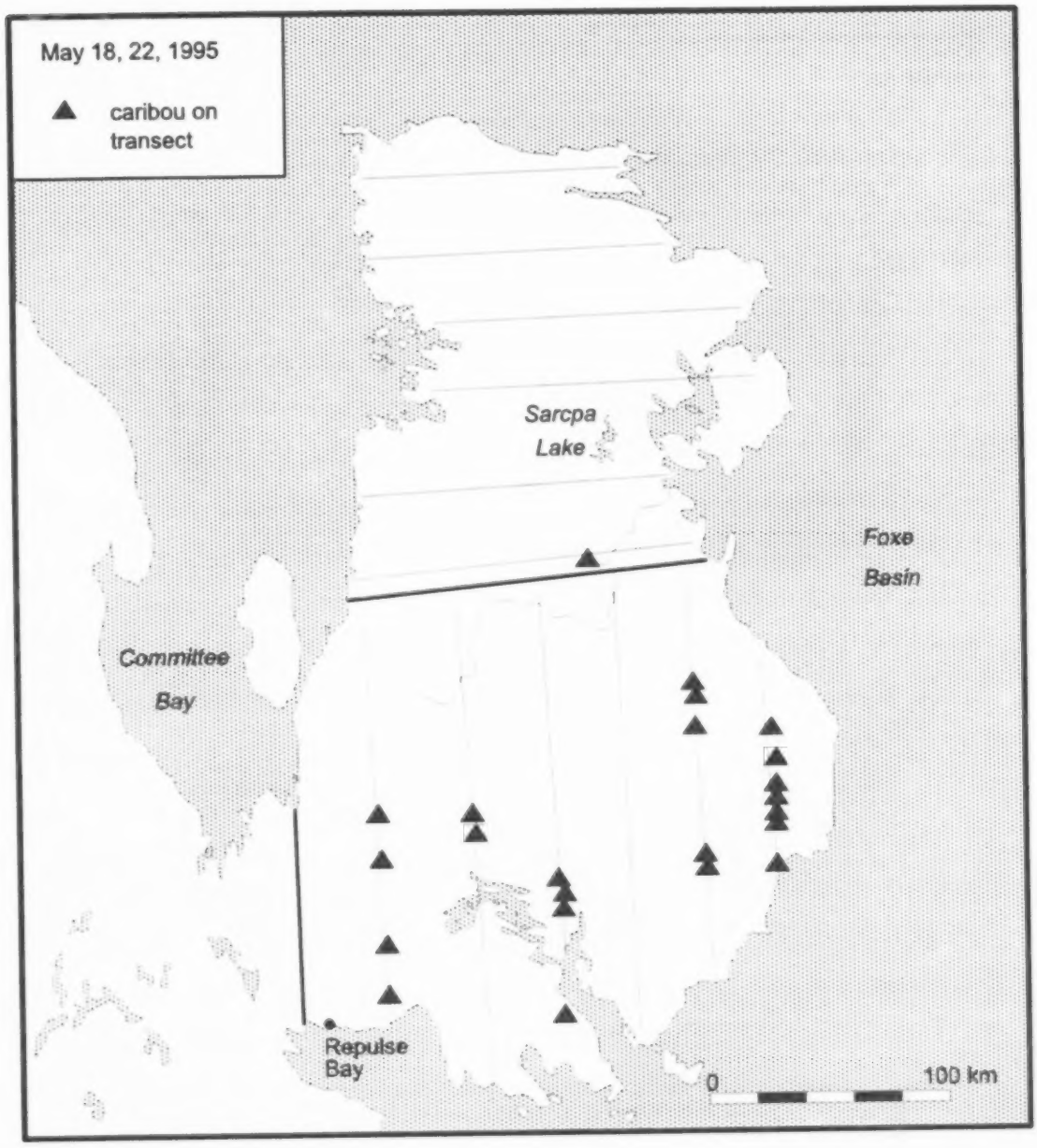

Figure 42. Melville Peninsula survey area, May 18,22, 1995, Buckland *et al., In prep.*

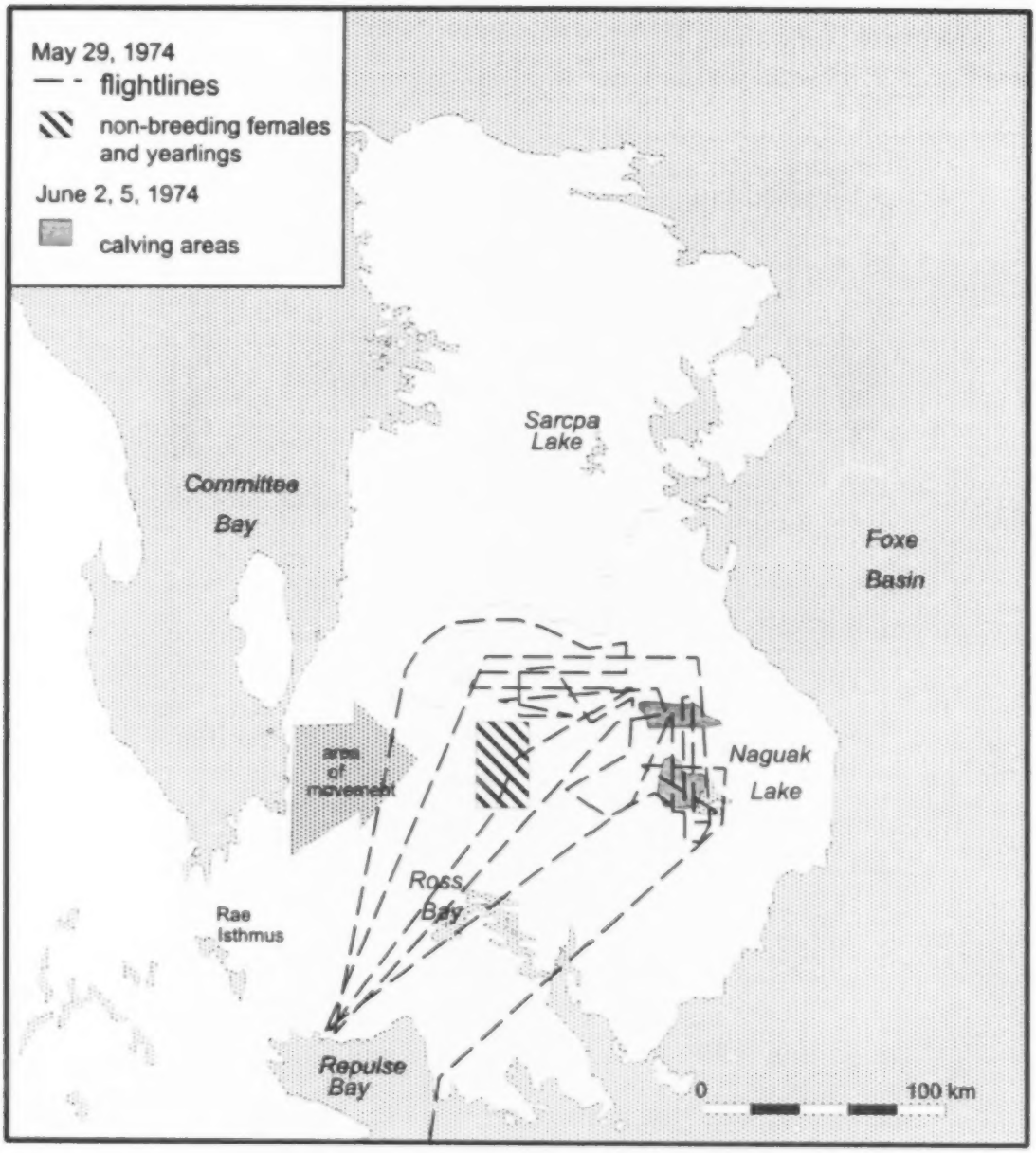

Figure 43. South Melville Peninsula survey area, May 29, June 2, 5, 1974, Bowden and Helmer, 1974.

counted were calves compared to 41 of 165 on 5 June.

1985 - 1988 June **Heard and Stenhouse 1992**

An investigation of calving ground fidelity was conducted by placing radio collars on caribou cows in the Keewatin district and locating them at calving. Sixty-two radio collars were put on in 1984, 40 were added in 1986 and 10 in 1987. No cows were located on southern Melville Peninsula in June 1985, but two cows were on southern Melville Peninsula in June 1986 (Figure 34). When these two cows were located by aerial reconnaissance, they were seen in a group of 10-20 cows and calves and there were six other small cow/calf groups in the vicinity in 1986. One cow, having calved at Wager Bay in 1986, was on Melville Peninsula in June 1987. In 1988, two cows returned in June to Melville Peninsula. Four of the collared cows changed between recognizable calving grounds: from Wager Bay to southern Melville Peninsula and from southern Melville Peninsula to Wager Bay.

1991 - 1993 June **Gunn and Fournier in prep.**

Nine cows were fitted with satellite collars to track their movements on Boothia Peninsula. One cow, collared on Simpson Peninsula in April 1991, migrated around Committee Bay crossing through the Rae Isthmus. She was not visually checked but she spent June midway between the head of Lyon Inlet and Committee Bay on the edge of the area mapped as a calving ground in 1976 (Figure 39). In July 1991, she returned west and spent the fall and the winter on the high ground west of Simpson Lake until she died in January 1992.

10. c) Post-calving surveys (late June)

1976 June 19-21 **Calef and Helmer 1981**

The survey's objective was to estimate population size and distribution for caribou on southern Melville Peninsula. The north-south transects (19-21 June 1976) systematically covered the interior of southern Melville Peninsula north of Lyon Inlet. Although two to three weeks had passed since calving, the cow/calf groups were still sharply separated from the bulls and juveniles and the authors delineated the calving ground's southern boundary by connecting the points on successive transects where cow-calf sightings ceased. The northern boundary was drawn from flying each transect several kilometres beyond the last recorded caribou (Figure 44). Few calves were recorded because of high densities encountered on the calving area. The report's maps show the outline of the calving ground and flight lines with caribou sightings.

11. Northern Melville Peninsula

Calving ground identification: We identified the northwest coast of Melville Peninsula as a calving area as we only had one year's information and although the aerial survey report was detailed, it did not map calving distribution. The survey was during early calving in 1982 and although the report indicated that the distribution of cows and calves on the west coast was similar to observations of calving in 1981, that report was not available.

Landscape and ecology: highlands, hilly with herbaceous vegetation and bare ground tundra.

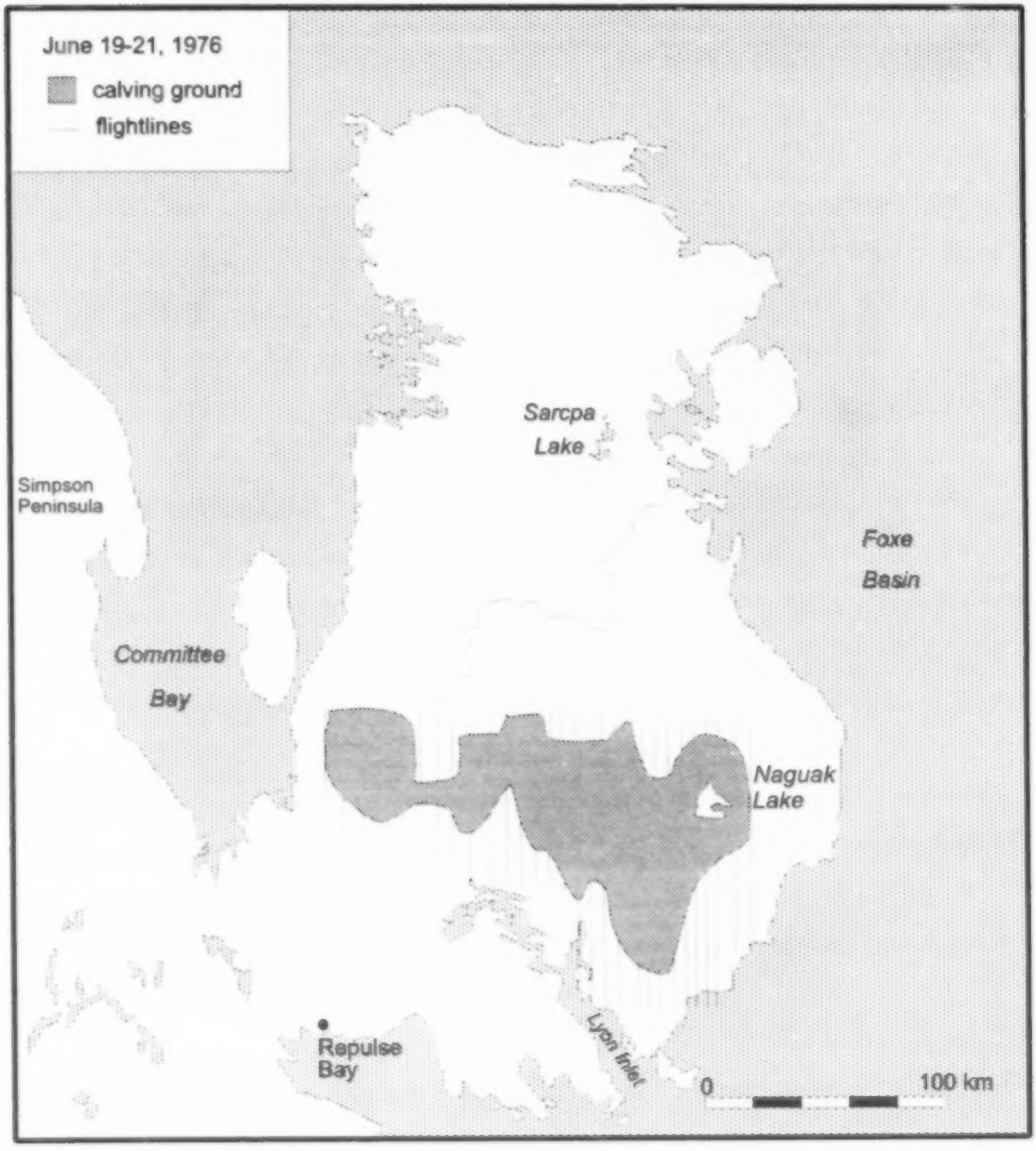

Figure 44. South Melville Peninsula survey area, June 19-21, 1976, Calef and Helmer 1981.

11. a) Pre-calving surveys

1983 May 4-11 **Heard *et al.* 1987**

This survey was to determine pre-calving distribution and abundance of caribou on the northeast mainland including northern Melville Peninsula. No movements were detected on northern Melville Peninsula (Figure 41). There were reports from the Sarcpa Lake Research Station of some cows moving north after calving. This research station reported that there was no record of calves seen before mid-July (5 years of data).

1995 May 19-23 **Buckland *et al.* in prep.**

The survey used the same stratification and methods as Heard *et al.* (1987) to estimate population size. These estimates were used to compare to the 1983 estimates. No discussion was made of distribution although a decline of caribou on Melville Peninsula was noted (Figure 42).

11. b) Calving areas (early to mid- June, newborn calves seen)

1981 June **Elliot and Elliot 1981**

This report was not available but Ferguson and Vincent (1992) refer to the report's observation of cows and calves on the northwest coast in June 1981.

1982 June 6-15 **Ferguson and Vincent 1992**

A survey of northern Melville Peninsula (north of 68° latitude) estimated caribou numbers, calving areas and productivity. Calving had only just begun during the survey as most of the cows (62%) still had hard antlers and there were few calves. The highest densities of caribou observed were distributed along the peninsula's west coast and in the southeast quarter of the study area (Figure 45). The map gives flight lines and caribou sightings but does not distinguish cows with calves from other caribou. However, the distribution is consistent with

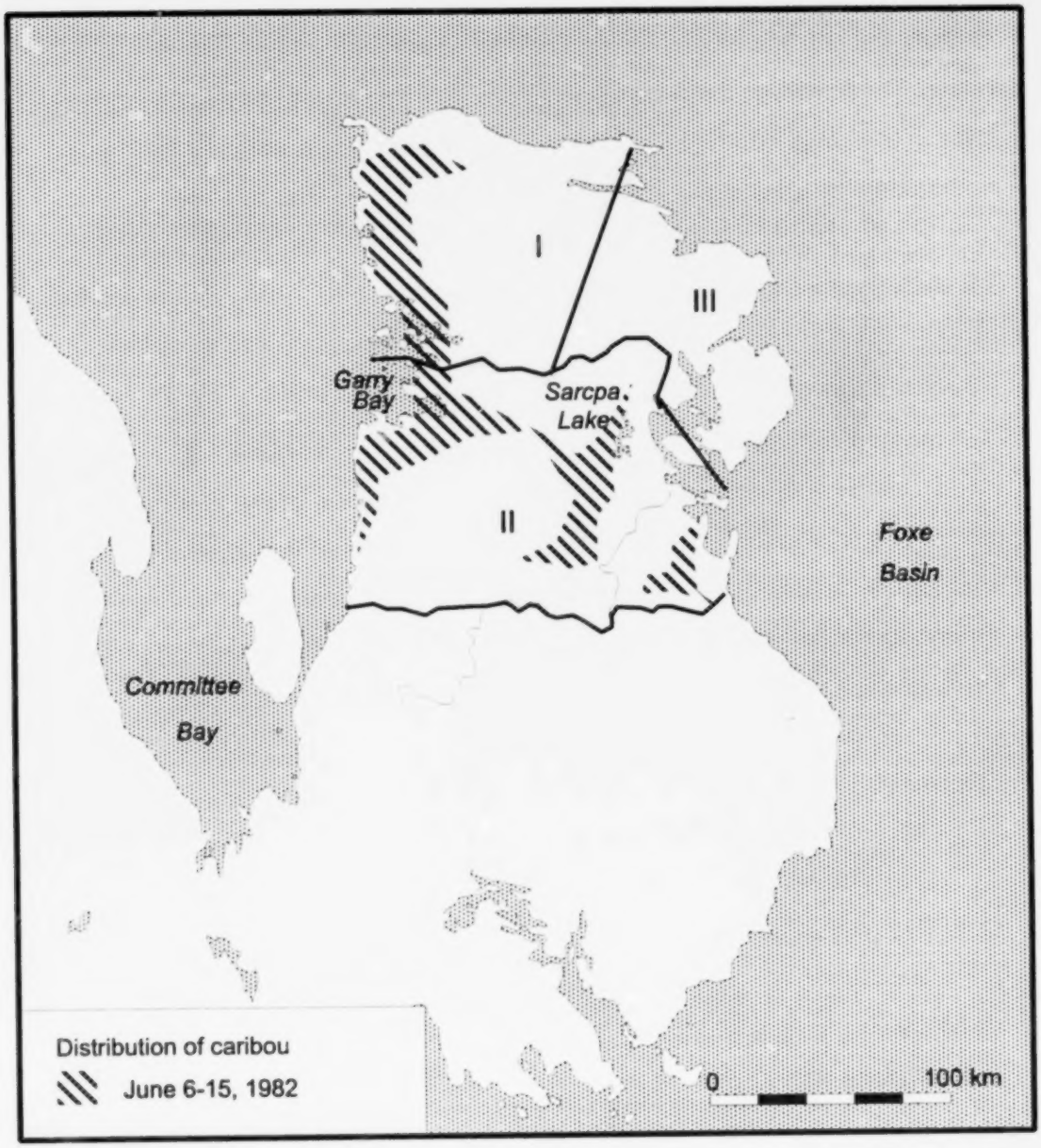

Figure 45. Northern Melville Peninsula survey area, June 6-15, 1982, Ferguson and Vincent, 1992.

hunters' reports of caribou moving from the east in late winter towards the west coast. The text describes cows and calves as being distributed south of Sarcpa Lake in the south-central portion of the survey area, south of Garry Bay, and north along the west coast of Melville Peninsula.

11. c) Post-calving surveys (late June): none.

12. Southampton Island

Calving ground identification: From the information available, we could not identify calving grounds although caribou do calve on the island. Most survey information is probably post-calving but dates for some of the surveys are unavailable. A summary report stated that "based on late June distribution surveys, cows did not appear to concentrate on a particular calving ground" but the basis for this statement was not apparent in the summarized data.

Landscape and ecology: characterized as rugged and sparsely vegetated herbaceous and bare ground tundra.

12. a) Pre-calving surveys: none

12. b) Calving surveys

1997 June 16 **Mulders in prep.**

Numbers of adult caribou (older than one year) were estimated by a stratified random block survey (Figure 46). No calves were recorded.

12. c) Post-calving surveys

1983, 1987, 1991 June **Ouellet 1992**

The report includes maps with flight lines and overall caribou distribution but

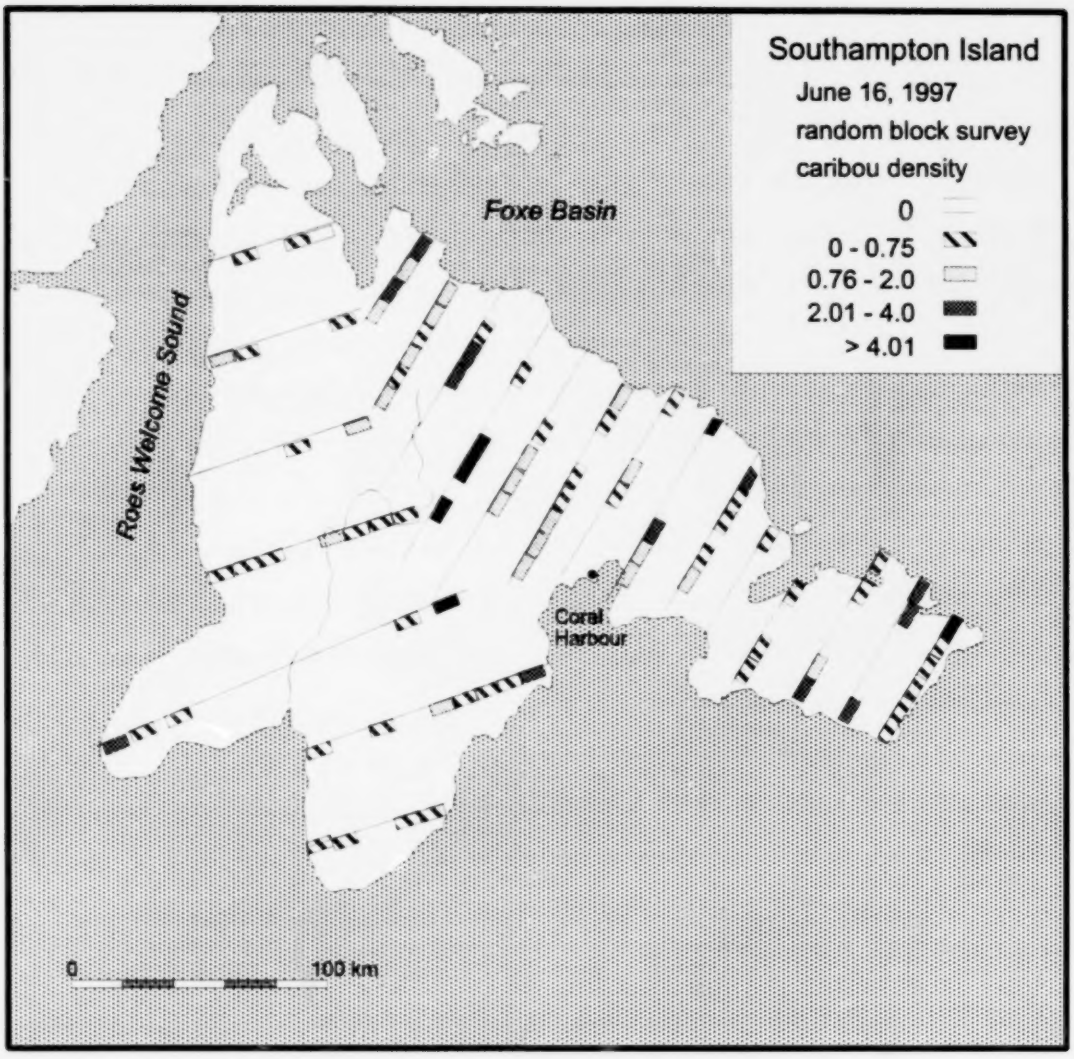

Figure 46. Southampton Island survey area, June 16, 1997, Mulders, *In prep*.

does not give the dates in June nor references to the original survey reports.

The author stated that "based on late June distribution surveys, cows did not appear to concentrate on a particular calving ground" and there was no reported difference between summer and winter distribution of caribou based on aerial surveys between 1978 and 1991. Between 1967 and 1983, caribou increased and expanded their range over the island but between 1983 and 1991, distribution did not change although numbers continued to increase.

25 June - 12 July 1983: A non-systematic aerial survey was conducted to collect wildlife inventory data and researchers reported that caribou densities were highest on the southern and eastern perimeters of the island, and north of Coral Harbour (Figure 47).

June 1987 and 1991: In 1987, a stratified random block survey was conducted to estimate population size and sex-age structure and the survey was repeated in 1991. The report included overall distribution maps (Figures 48 and 49) but the cow-calf distribution was not mapped. The report did not give survey dates or mention whether calves were newborn, but the calf-cow ratios suggested that calving had finished.

1995 July 1-3, 8-17 **Mulders in prep.**

Due to logistical problems, a stratified systematic transect survey was conducted, instead of a 'random block' design as in previous years, to determine estimated caribou numbers (older than one year). No calves were recorded and no map was available.

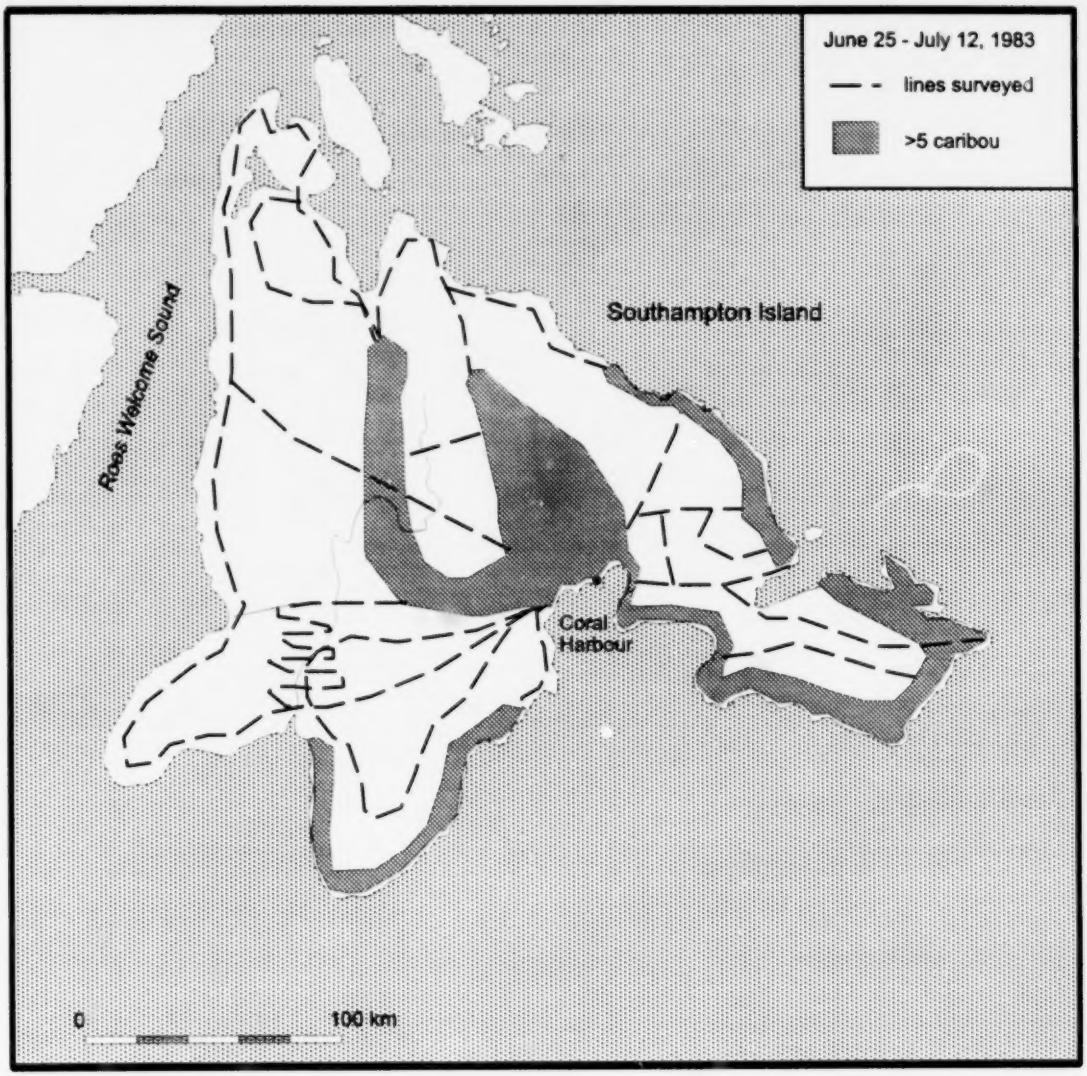

Figure 47. Southampton Island survey area, June 25- July 12, 1983.

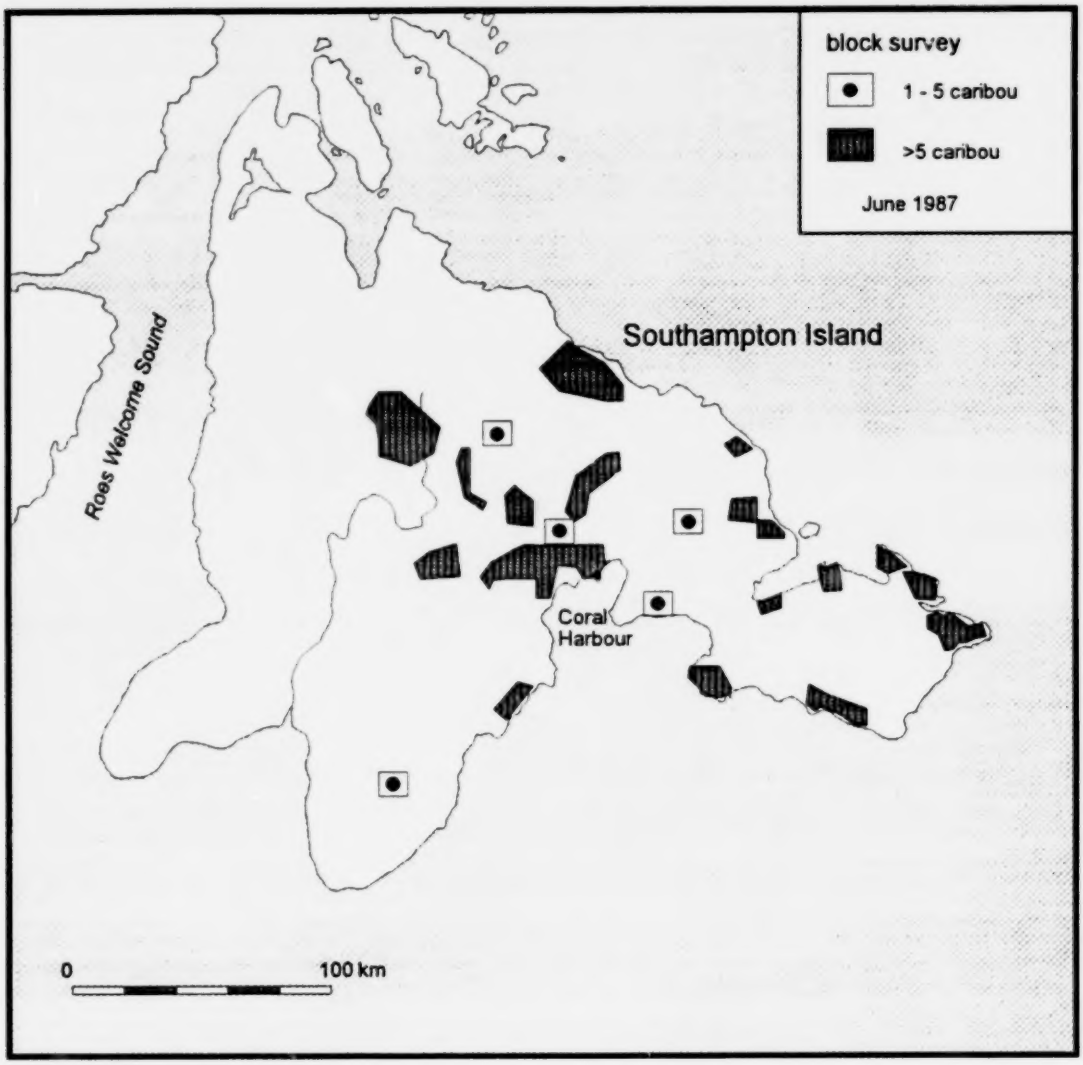

Figure 48. Southampton Island survey area, June 1987.

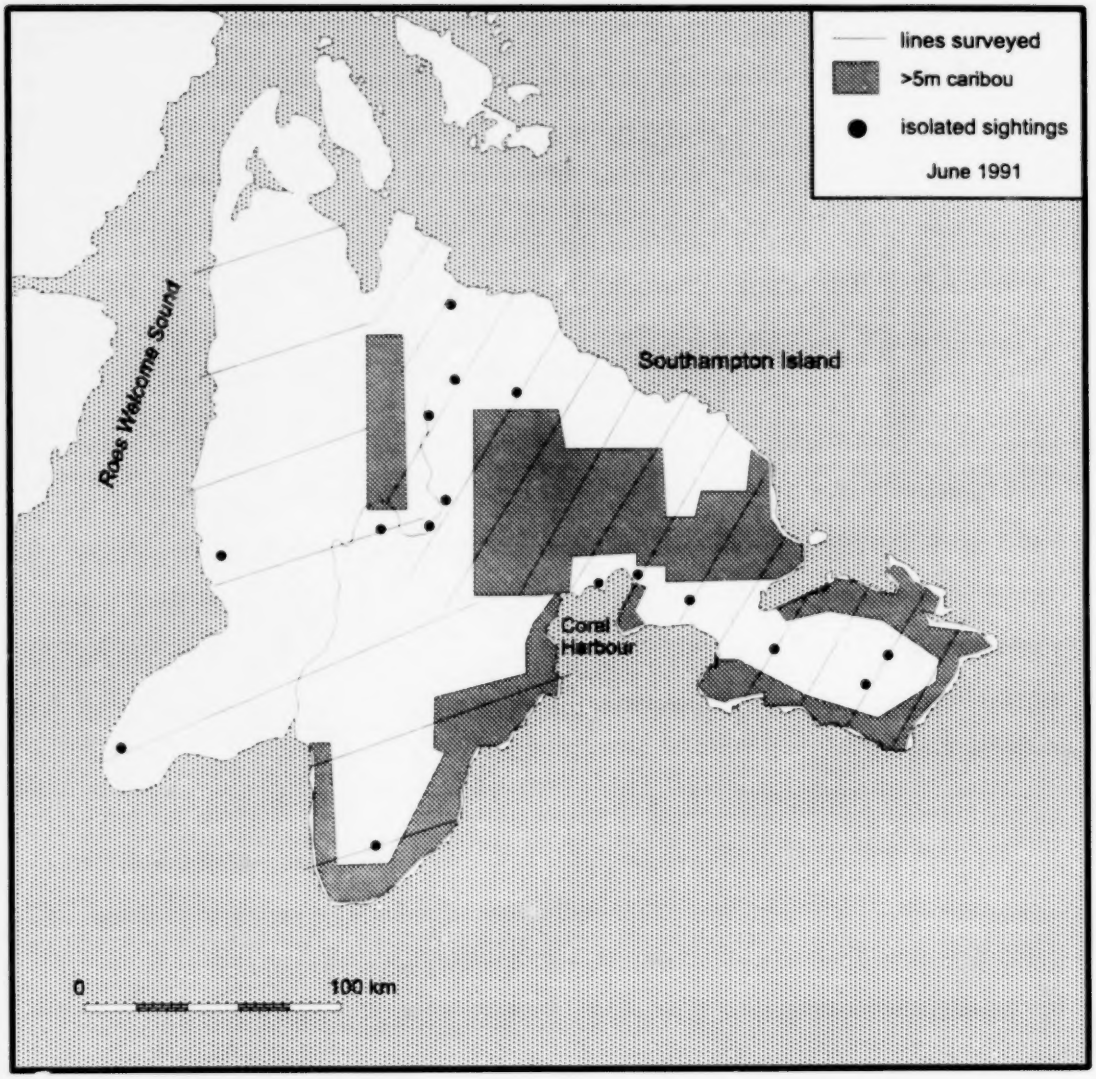

Figure 49. Southampton Island survey area, June 1991, Heard, unpubl.

13. Coats Island

Calving ground identification: Identification of a calving ground was not possible as aerial surveys were pre- or post-calving, although caribou do calve on the island.

Landscape and ecology: characterized as lowlands of sparsely vegetated herbaceous and bare ground tundra.

13. a) Pre-calving surveys

1972 May **Rippen and Bowden 1972a**

The systematic aerial survey was to estimate caribou numbers. Most caribou were on coastal raised beaches and tundra pond areas. None were seen in the central upland area (Figure 50). The actual survey days were not given in the report. The report includes the original survey map with flight lines and observations.

1974 May 23 **Bowden and Helmer 1974a**

The systematic survey was to estimate caribou numbers. Few caribou were found in the central uplands of the island. Authors commented on transects 10 - 13 (coastal area of Calanus Bay) as a probable calving area, where a high proportion of cows observed exhibited behaviour "similar to that of other caribou seen on known calving grounds", although no calves were seen in May (Figure 51). The report includes the original survey map with flight lines but no observations.

13. b) Calving areas (early to mid- June, newborn calves seen)

No surveys were conducted.

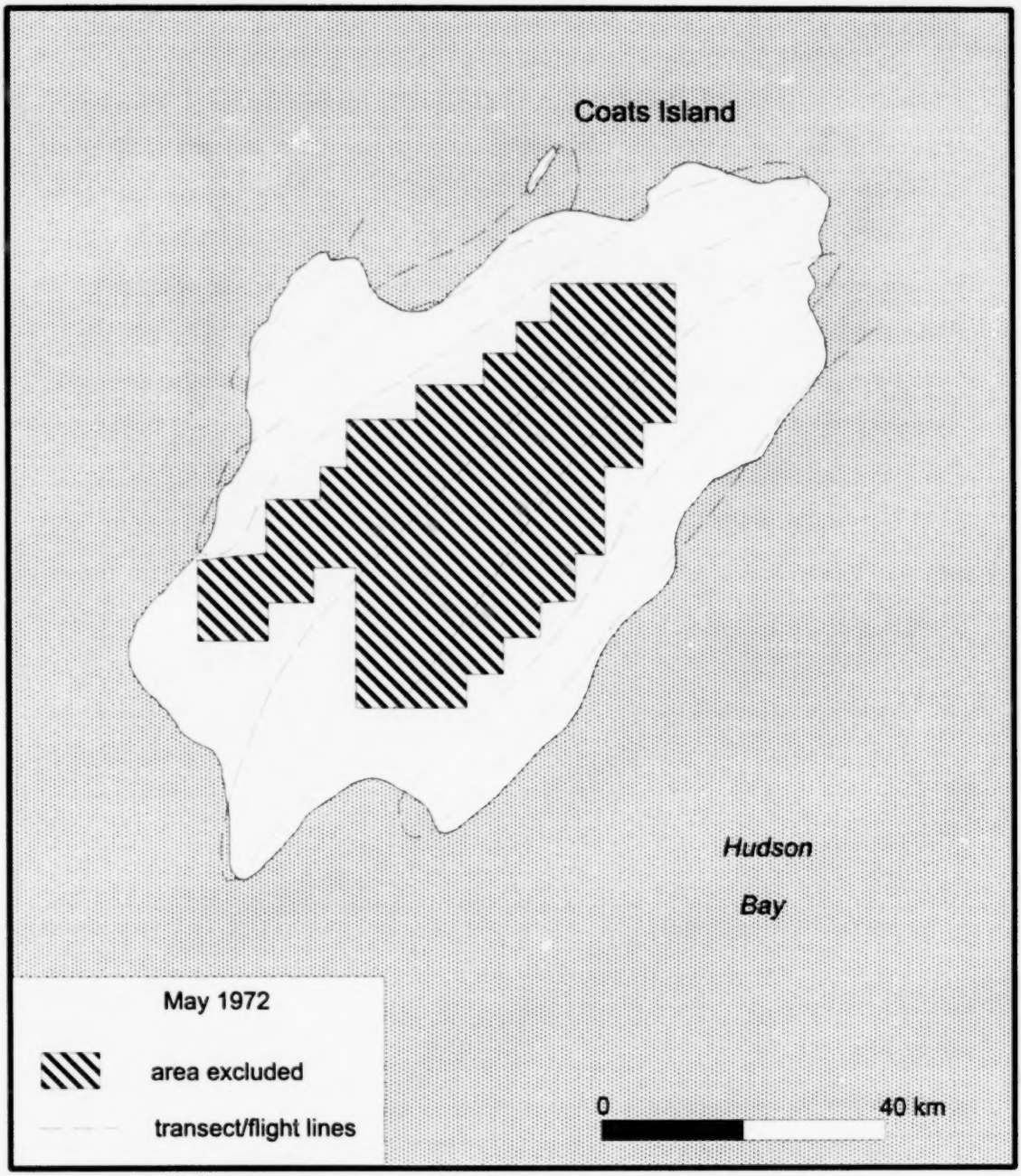

Figure 50. Coats Island survey area, May 1972, Rippen and Bowden 1972a.

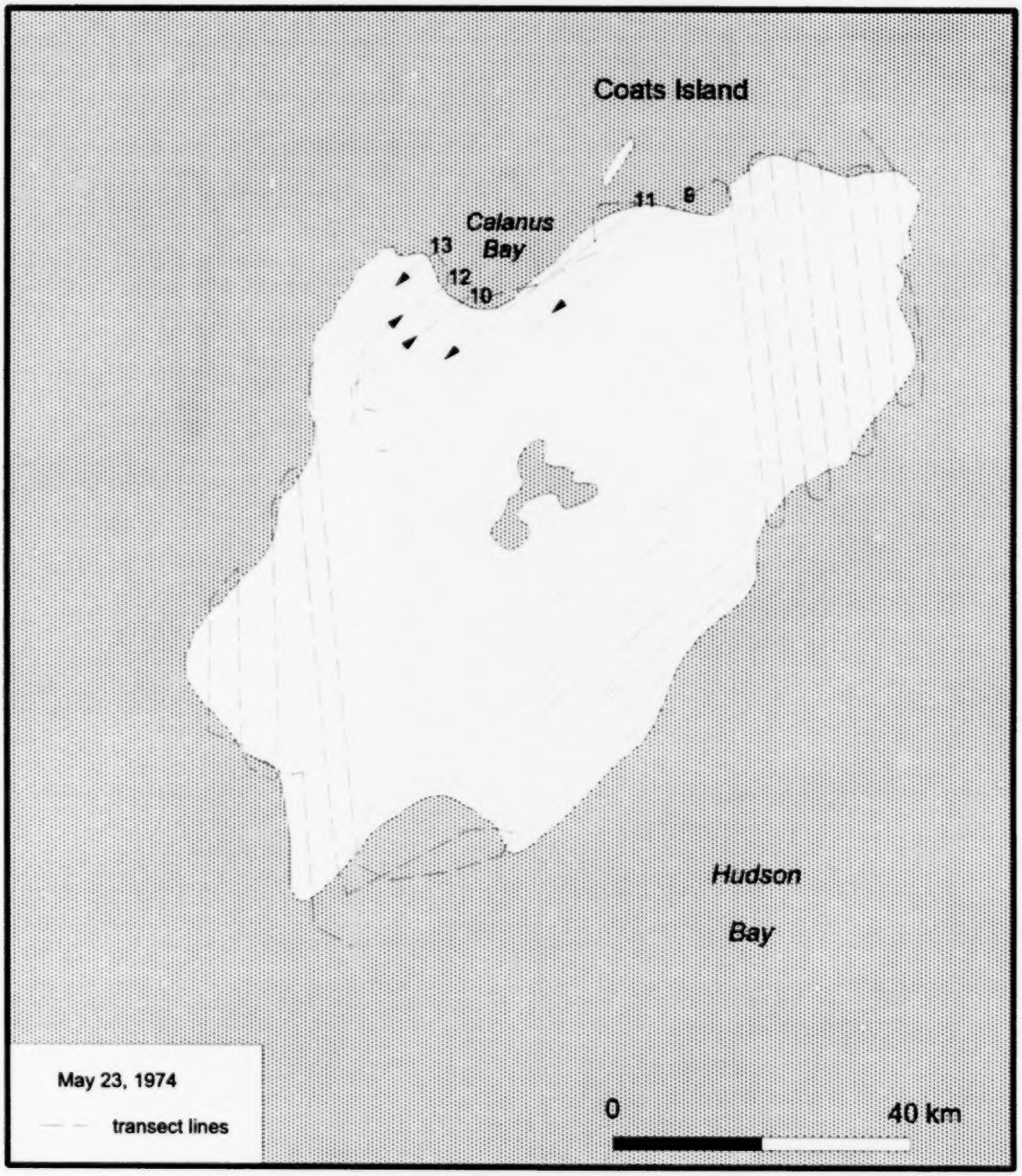

Figure 51. Coats Island survey area, May 23, 1974, Bowden and Helmer 1974.

13. c) Post-calving surveys (late June)

1975 June 28-29 **Helmer and McNeil 1975**

Gates *et al.* (1986) provided some information on this systematic aerial survey to estimate population size. No original report with survey map or distribution information was available.

1980 June 28-29 **Gates *et al.* 1986**

Again, Gates *et al.* (1986) provided some information on this systematic aerial survey to estimate population size. No original report with survey map is available. Systematic surveys revealed the southwest and east sections of the island held greatest densities of caribou in late June 1980. Calf production was reported as being severely depressed (32 calves out of 342 caribou seen) after a severe winter. The cows and calves seen were on the southwest coast (A. Gunn field notes).

1984 June **Heard and Decker 1984**

Again, Gates *et al.* (1986) provided some information on this systematic aerial survey to estimate population size. No original report, survey map, or distribution information was available. As Gates *et al.* (1986) commented that fewer than half of the cows in the population had calves at heel in late June, we have assumed that the survey was post-calving.

14. Northwest Victoria Island

Calving ground identification: The calving ground identification was based on one systematic aerial survey in 1987 that delineated a calving distribution and an unsystematic survey in 1988 that recorded calving in an area overlapping that used in 1987 (Figure 52). During both years, satellite-collared cows calved

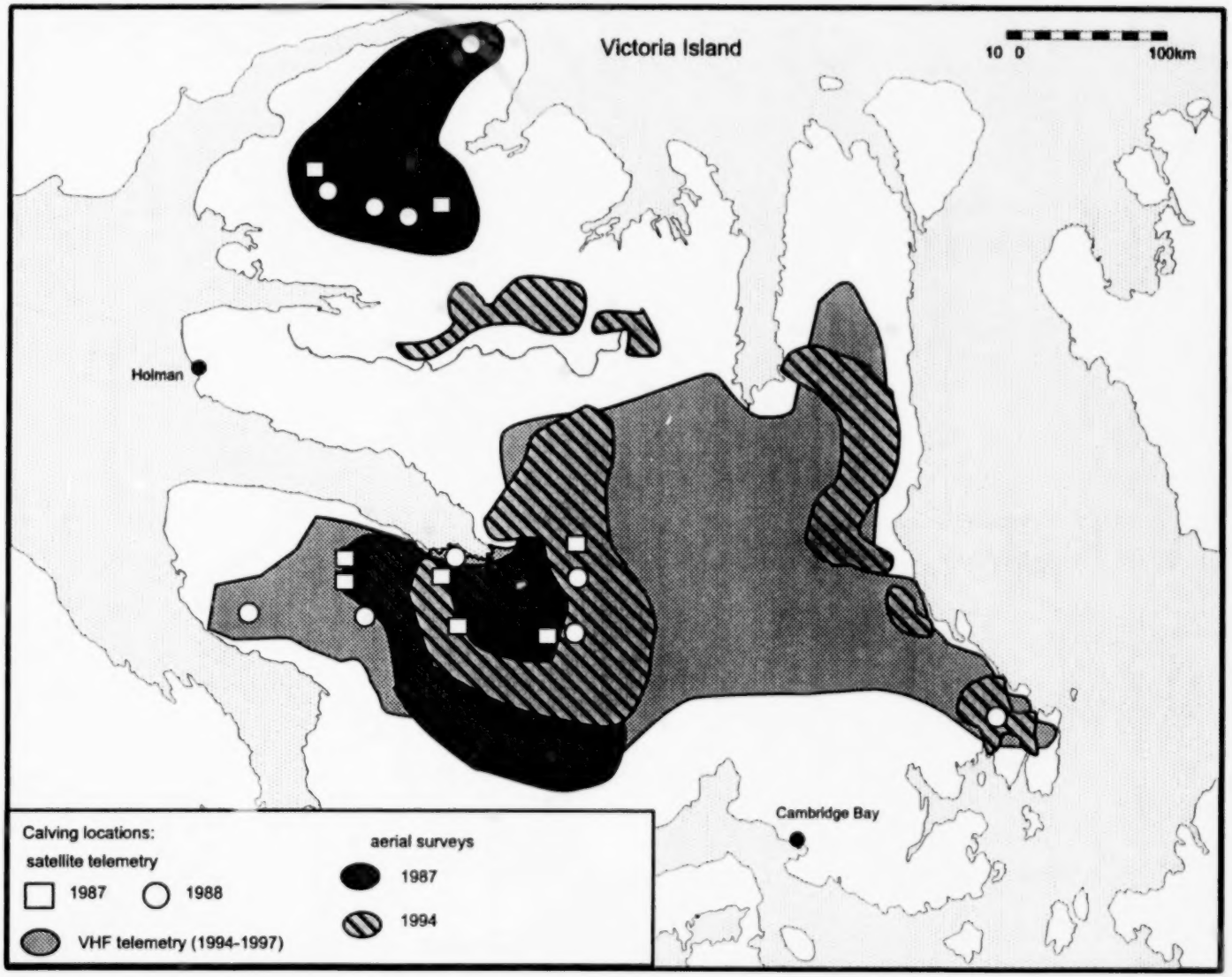

Figure 52. Calving locations on Victoria Island, 1987 - 1997.

within the delineated calving ground. Caribou numbers were declining and a 1994 survey recorded no calving or caribou in the area.

Landscape and ecology: coastal and hilly, with sparsely vegetated herbaceous and bare ground tundra.

14. a) Pre-calving surveys: none.

14. b) Calving areas (early to mid- June, newborn calves seen)

1982 June 7-9, 1983 June 4-6 **Kiliaan and Thomas 1983**

Unsystematic aerial surveys were flown to determine spring caribou movements in the Prince of Wales Strait between Banks and Victoria islands. In 1982, no caribou or trails were sighted, nor were concentrations of caribou observed in coastal areas of Banks and Victoria islands (Figure 53). During the 1983 survey, 31 caribou were on Prince Albert Peninsula and a cow and newborn calf were 60 km east of Minto Inlet [survey map did not include the full area surveyed and the cow-calf observation was not shown]. An account is given of local knowledge of caribou funnelling back between the west side of the Shaler Mountains and Minto Inlet in the spring to calve on Prince Albert Peninsula. After calving, the caribou were reported to move up the northern part of the Peninsula to summer.

1985 June 4-13 **Miller 1986**

An unsystematic survey was flown to search for inter-island movements between Banks and Victoria islands. Although no caribou calving area was found on Victoria Island, from 28 May to 12 June 1985, Miller (1986) observed 72 cows and 23 newborn calves on Prince Albert Peninsula west of the coastal plain in intermediate grounds, 150-300m above sea level, and east of the highlands.

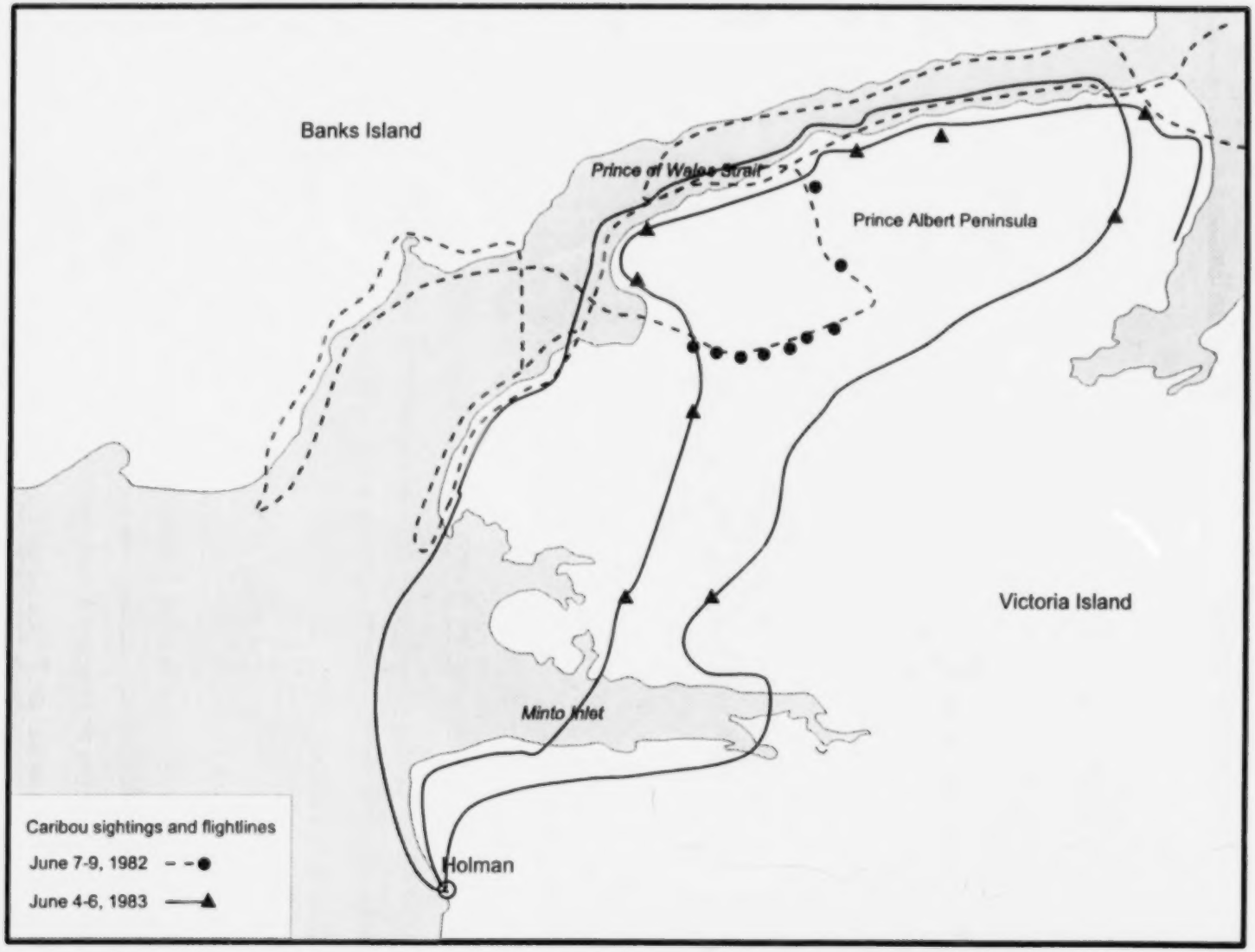

Figure 53. Victoria Island survey area, June1982 and June 1983, Kiliaan and Thomas 1983.

The highland calving area suggested by Jakimchuk and Carruthers (1980) was not found. The author commented that breeding cows seen on Banks and Victoria islands were most always found on sites within 150-300m above sea level. His sightings of concentrations of caribou near Deans Dundas Bay included a high proportion of bulls, juveniles and yearlings. From this, Miller (1986) offered three options: (1) the cows and calves "missing" from Prince Albert Peninsula calved near Jesse Bay, Banks Island (where Miller had seen a concentration of cows and newborn calves in June 1985; (2) the calving area on Prince Albert Peninsula lay further east of Deans Dundas Bay on the higher ground; or (3) the searching effort in June 1985 was not enough to locate the calving area. Our 1987-88 telemetry and surveys suggest that both options 2 and 3 were reasonable explanations for Miller's (1986) observations.

1987- 1988 June **Gunn and Fournier in prep. b.**

(aerial surveys and satellite-telemetry)

Satellite collars fitted to cows were used to determine seasonal movements with aerial surveys for visually locating the cows in June to ascertain calving status. The draft report has maps with survey lines and observations. The calving and rutting distribution indicated that the caribou on northwest Victoria Island were a separate herd. In 1987, two collared cows calved on 5-6 June but the survey was not until 21 June 1987 when we counted 37 caribou and 14 calves on the 477 km of transect on northwest Victoria Island (Figure 54). East of Deans Dundas Bay and north of Minto Inlet, we flew north-south transects from the coast. To determine the eastern boundary of the calving area, we oriented the transects east-west. The survey coverage was 6% and the caribou were distributed inland from Deans Dundas Bay in a continuous belt some 100 km west to east and 50 km north-south. The north and south extent of the calving area was likely not fully delimited as fog and shortage of hours prevented north-

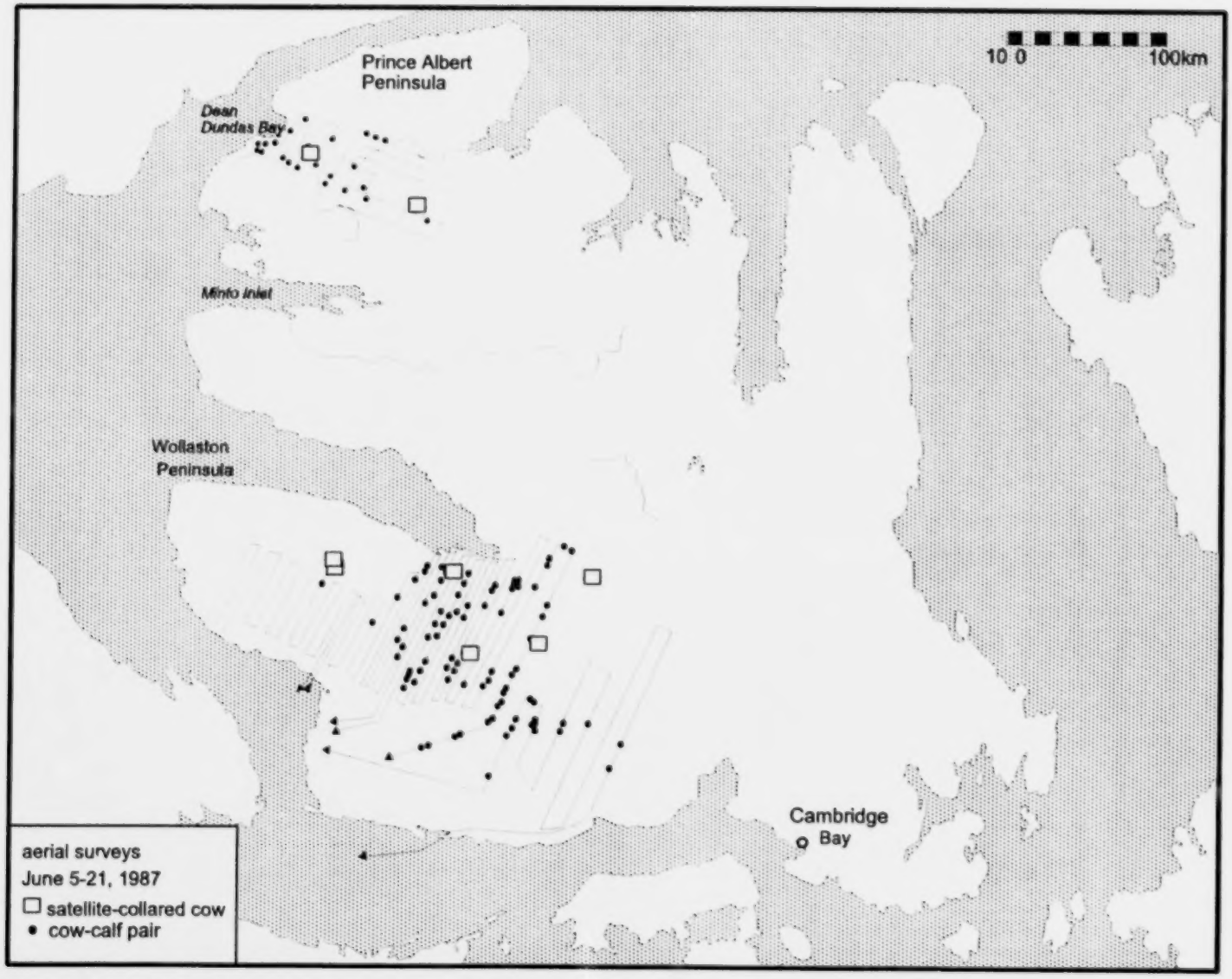

Figure 54. Victoria Island survey area and satellite telemetry study, June 5-21, 1987 , Gunn and Fourmier in prep.

south extensions of the transects.

On 18 June 1988, we counted 33 caribou and 17 calves during the survey of northwest Victoria but coverage was too sparse to describe distribution (Figure 55). Three of the radio-collared cows calved southwest of Richard Collinson Inlet and the fourth radio-collared cow calved at the north end of Prince Albert Peninsula. We did not determine if there was a concentration of caribou in the vicinity of Deans Dundas Bay as in 1987. Of the three radio-collared cows calving southwest of Richard Collinson Inlet, one had another cow-calf pair within about one km of her, one was with another cow-calf pair and 9 cows with 4 calves were in the immediate vicinity. The third was with an antlered cow. The cow that was further north on the coast had another cow-calf pair in the vicinity.

1993 June 13-15 **Gunn in prep.**

We considerably expanded our survey area in June 1993 compared to 1987 to estimate population size. We counted 15 caribou and one calf on 2114 km of transects and 5 caribou off transect on 13 - 15 June 1993. The coverage was 16%. The few caribou found during the extensive coverage of Prince Albert Peninsula were in four groups including a cow-calf pair near the coast north of Deans Dundas Bay. There is no map available at this time.

We flew four times the length of the transects flown in 1987 and covered the annual range of the caribou as determined from the satellite telemetry. The increase in the area covered was in recognition that snowfall had been exceptionally high and may have delayed or prevented the return of the caribou cows to their calving area.

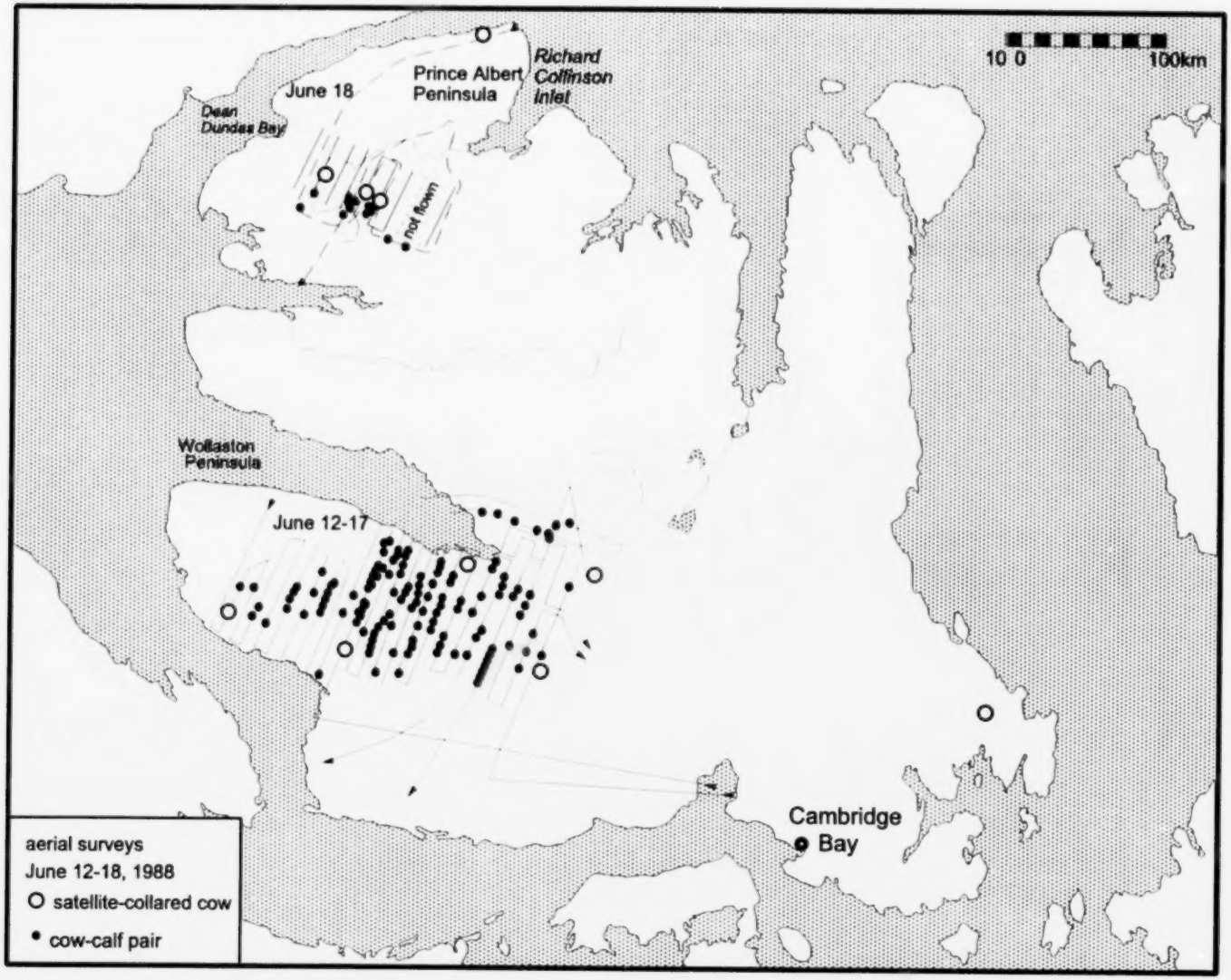

Figure 55. Victoria Island survey area and satellite telemetry study, June 12-18, 1988 , Gunn and Fourmier in prep.

1994 June 5-16 **Nishi in prep.**

A systematic transect survey was conducted on western Victoria Island on 5-14 June 1994 to estimate the numbers and distribution of caribou (Figure 56). The survey stratum for northwest Victoria Island covered the known range of Minto

Sightings of calves were mapped during this survey. On June 15 and 16, 1994, systematic transect surveys were conducted in the Shaler Mountain area of northern Victoria Island and observations of calves were mapped.

14. c) Post-calving surveys

1980 July 29 - August 2 **Jakimchuk and Carruthers 1980**

A systematic aerial survey was flown to obtain baseline information on caribou abundance and distribution as part of the environmental assessment for a proposed gas pipeline (Figure 57). Caribou were concentrated on the lowlands at the head of Richard Collinson Inlet and on the Prince Albert Peninsula with cows and calves occurring proportionately more often on sites at greater than 150 m above sea level. The report suggested that caribou calved on the highlands of the interior of Prince Albert Peninsula.

15. Victoria Island - Dolphin and Union Strait

Calving ground identification: Identification of the calving ground began with two aerial surveys in 1987 and 1988 with six satellite-collared cows. The delineated calving grounds were likely incompletely mapped on the eastern edge both in 1987 and 1988. Likewise, the next systematic aerial survey in 1994 did not survey beyond the eastern edge of the cow-calf distribution. The 1994 survey did, however, identify a separate area of calving north of the 1987 and 1988 calving distribution but the data do not distinguish whether it was a calving

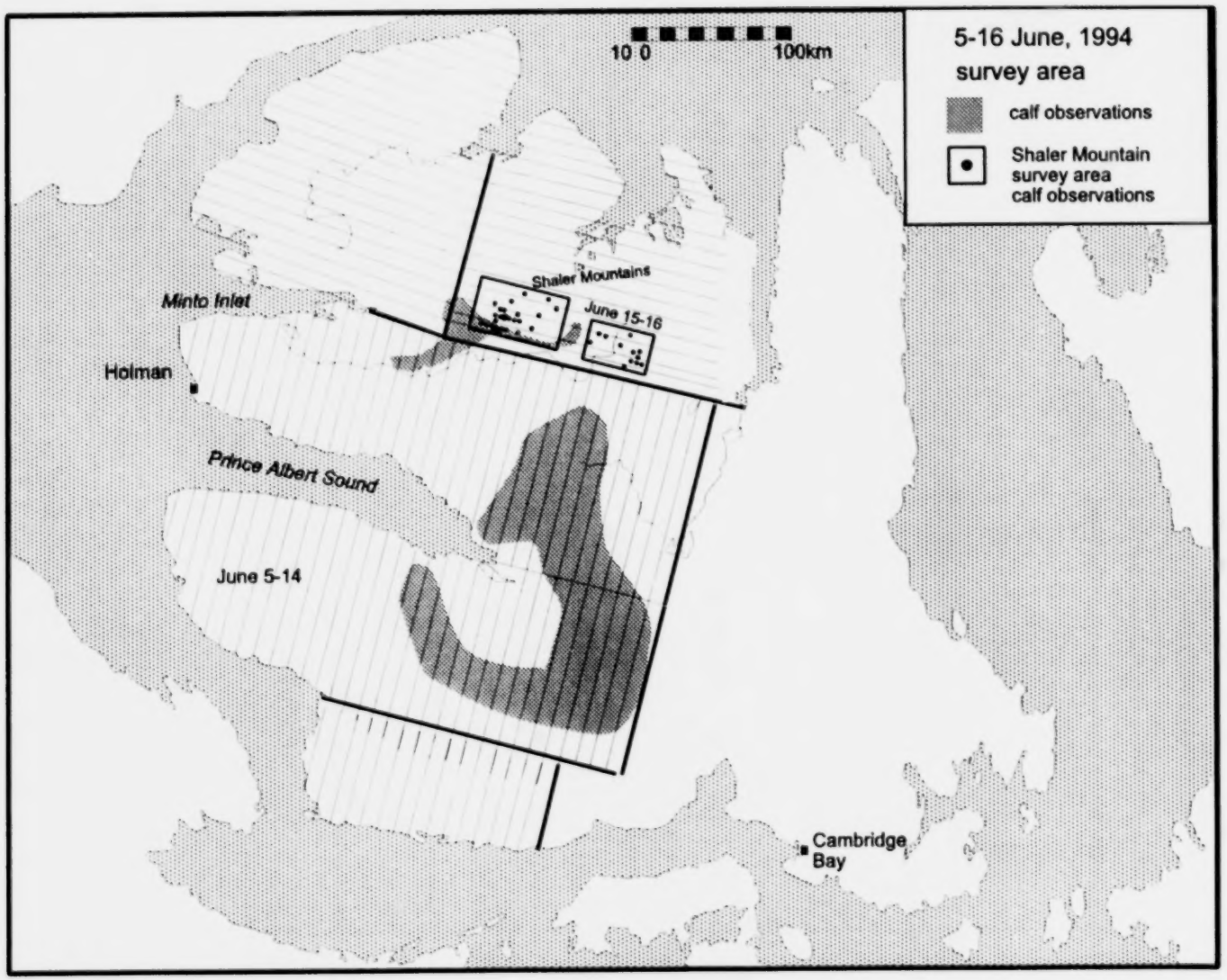

Figure 56. West Victoria Island survey area, June 5-16, 1994, Nishi in prep.

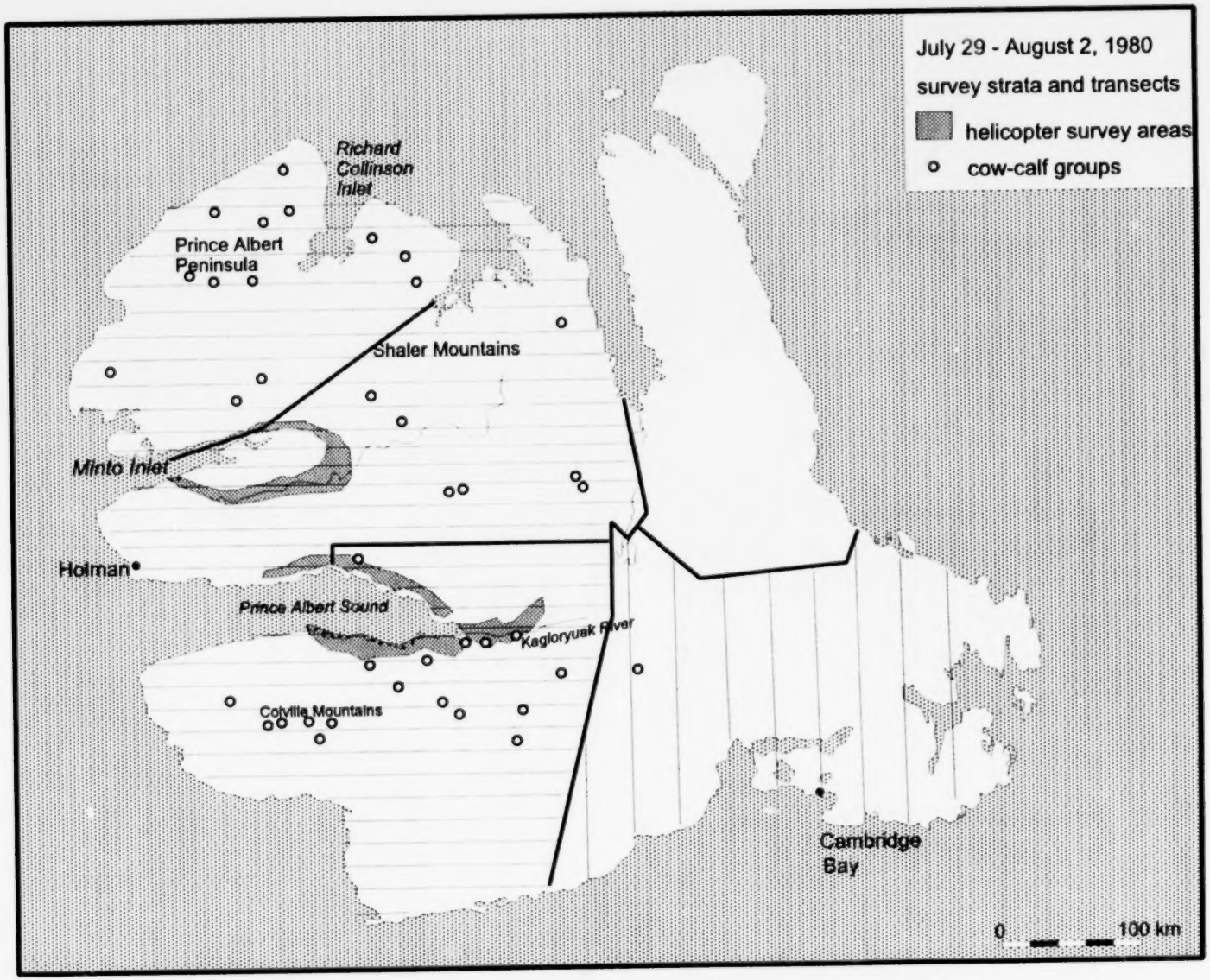

Figure 57. Victoria Island survey area, July 29 - August 2, 1980, Jakimchuk and Carruthers 1980.

or post-calving area as the satellite data indicated that the cows moved north after calving. Subsequently, four years of radio-tracking (1994-97) revealed scattered calving over central and eastern Victoria Island which, on the west, overlapped with the calving grounds delineated in 1987, 1988 and 1994. The areas used by radio-collared cows were used for more than one year and thus, met the definition of a calving ground.

Landscape and ecology: lowlands of sparsely vegetated herbaceous and bare ground tundra.

15. a) Pre-calving surveys: none.

15. b) Calving areas (early to mid- June, newborn calves seen)

1987 - 1988 **Gunn and Fournier in prep. b**

(aerial surveys and satellite-telemetry)

Satellite collars fitted to cows were used to determine seasonal movements with aerial surveys for visually locating the cows in June to ascertain calving status. The draft report has maps with survey lines and observations. The calving and rutting distribution indicated that the caribou on west and central Victoria were a separate herd.

In 1987, visual checks of the cows gives the range of calving dates as 5-21 June 1987. Two cows calved on higher ground (300 m above ground level) inland on Wollaston Peninsula, one cow calved on the coast and the other three cows calved on the central low-lying area (Figure 54). Spring was considered to be two to three weeks late but it is not clear to what extent, if any, the poor weather contributed to the scattered distribution of calving.

On 21 June 1987, we flew 1601 km on transect and counted 642 caribou and 95 newborn calves on west-central Victoria Island. However, the flights did not completely bound the calving ground as we saw two cow-calf pairs on the easternmost transect and two pairs on the northernmost line (Figure 54). In 1987, two collared cows were on the northwest margin, two were within the area covered by the transects, and two were northeast of the main surveyed area. One may have lost her calf after 5 June and continued moving north; the other was also on the northern boundary and was late calving (after 17 June).
In June 1988, we visually checked each collared cow only once. During the survey between 12 and 18 June, we saw five collared cows with calves which we gauged to be a few days old and one cow had lost her calf. In 1988, our data were only sufficient to state that one calf was born on 17 June and three calves had been born by 18 June.

Between 12 and 18 June 1988, we mapped the distribution of calving during north-south transects on west-central Victoria Island covering a similar area to 1987 but extended further south and to the northeast (Figure 55). We flew 2155 km on transect and counted 805 caribou and 203 calves. We observed no evidence of calving in the southeast toward the coast. The amount of flying was insufficient to delimit the calving grounds which had diffuse boundaries - we were still observing cow-calf pairs on the easternmost transect line for the two calving grounds in 1987 and the one calving ground surveyed in 1988.

1994 - 1997 **Nishi in prep.**

(aerial survey and radio tracking)

On 17-18 June 1994, 8-9 and 17-18 June 1995, 14-16 June 1996, and 10-12 and 16-18 June 1997, reconnaissance surveys were conducted over eastern and southwestern Victoria Island to locate radio-collared cows and to document

calving. Observation of collared cows showed calving occurs extensively over the southern portion of Victoria Island (Figure 58-61). In June 1994, the author flew a systematic survey of western Victoria Island and divided the area into five strata based on general topography of the island and expected distribution of pregnant caribou during calving (Figure 56). Sightings of calves were mapped during this survey.

15. c) Post-calving surveys

1980 July 29 - 2 August **Jakimchuk and Carruthers 1980**

The systematic aerial survey was to obtain baseline information on caribou abundance and distribution as part of environmental assessment for a proposed gas pipeline (Figure 57). The western half of Victoria Island contained over 90% of the caribou population. Concentrations were found at the head of Prince Albert Sound and it is noted that females and calves were more often seen at elevations greater than 150m asl during the survey. The authors comment that historical accounts (Jenness 1959), local knowledge and sightings of large numbers of cow-calf groups were their reasons to suspect calving areas in the Colville Mountains and in lowlands areas along the Kagloryuak River.

16. Prince of Wales, Russell and Somerset islands

Calving ground delimitation: Incidental observations during unsystematic surveys identified northwest Prince of Wales Island as a calving ground and west Somerset Island as a calving area (Figure 62) but the degree of overlap between years is difficult to gauge due to the lack of distribution maps in some reports and the annual variation in timing of inter-island migration between the two islands. Systematic coverage during transect surveys delineated areas with cows and calves in 1975, but as the timing of calving relative to that distribution is unknown, the calving grounds were identified but not delineated during the surveys between 1974 and 1989.

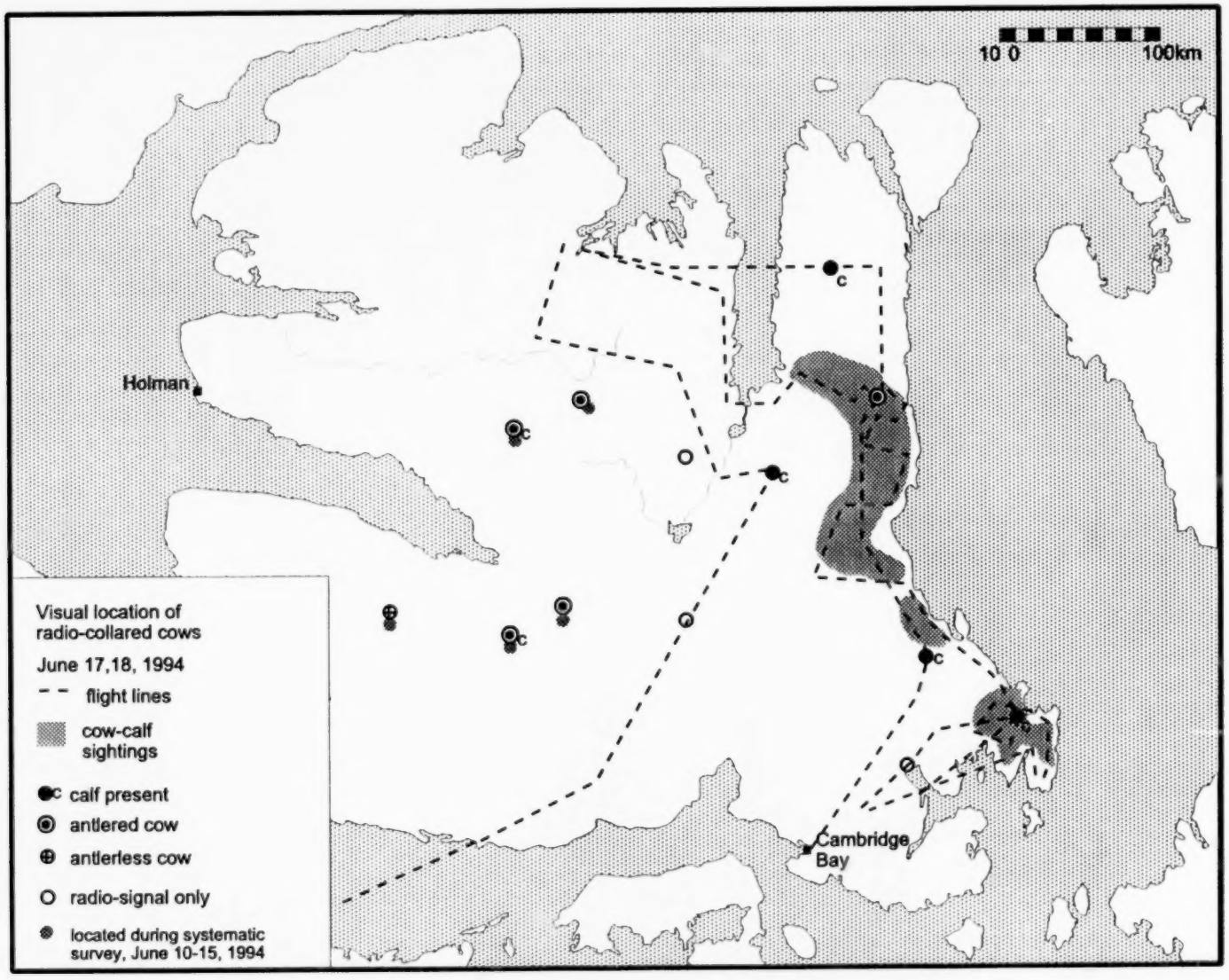

Figure 58. Victoria Island radio-telemetry calving survey, June 17-18, 1994, Nishi in prep.

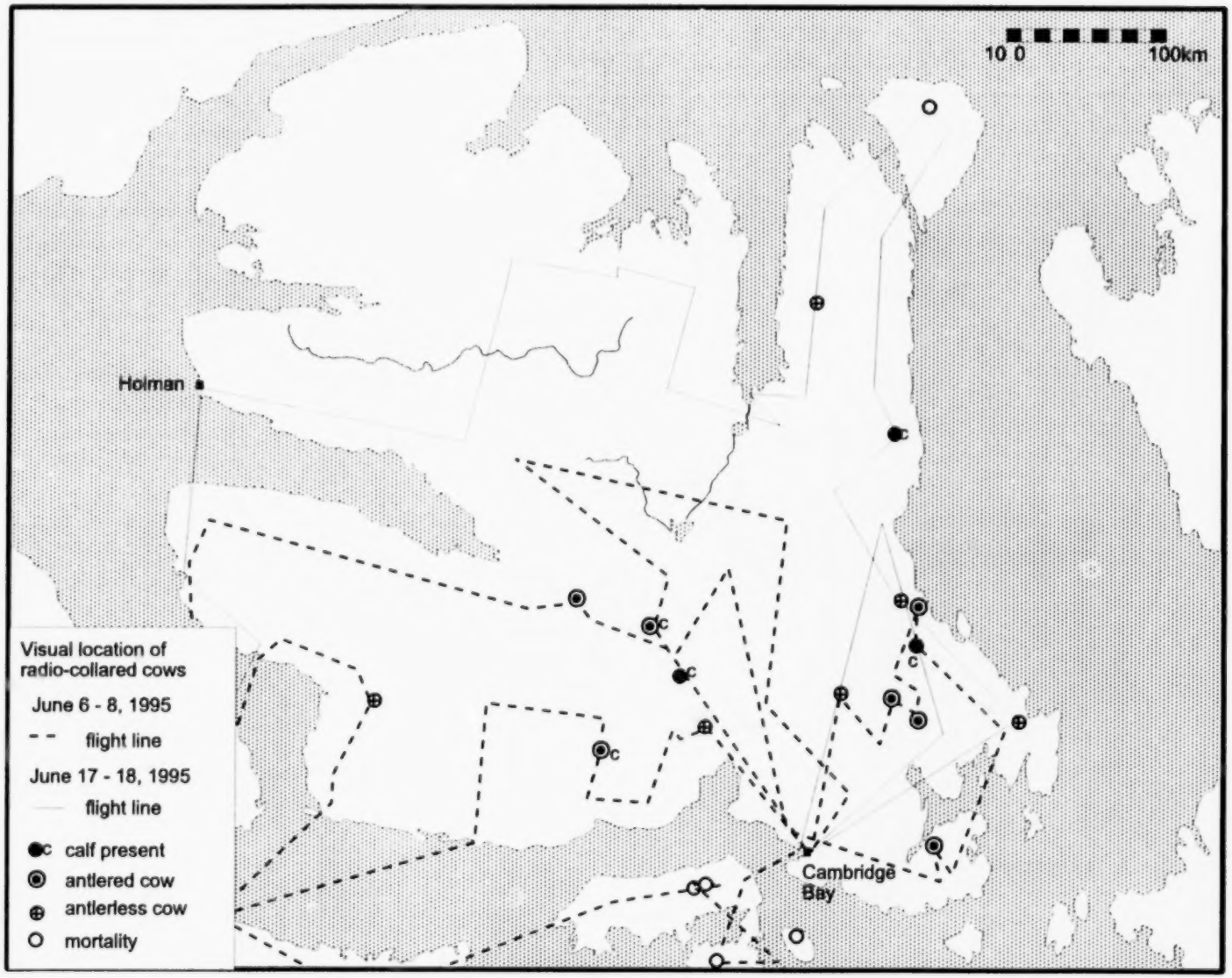

Figure 59. Victoria Island radio-telemetry calving survey, June 6-18, 1995, Nishi in prep.

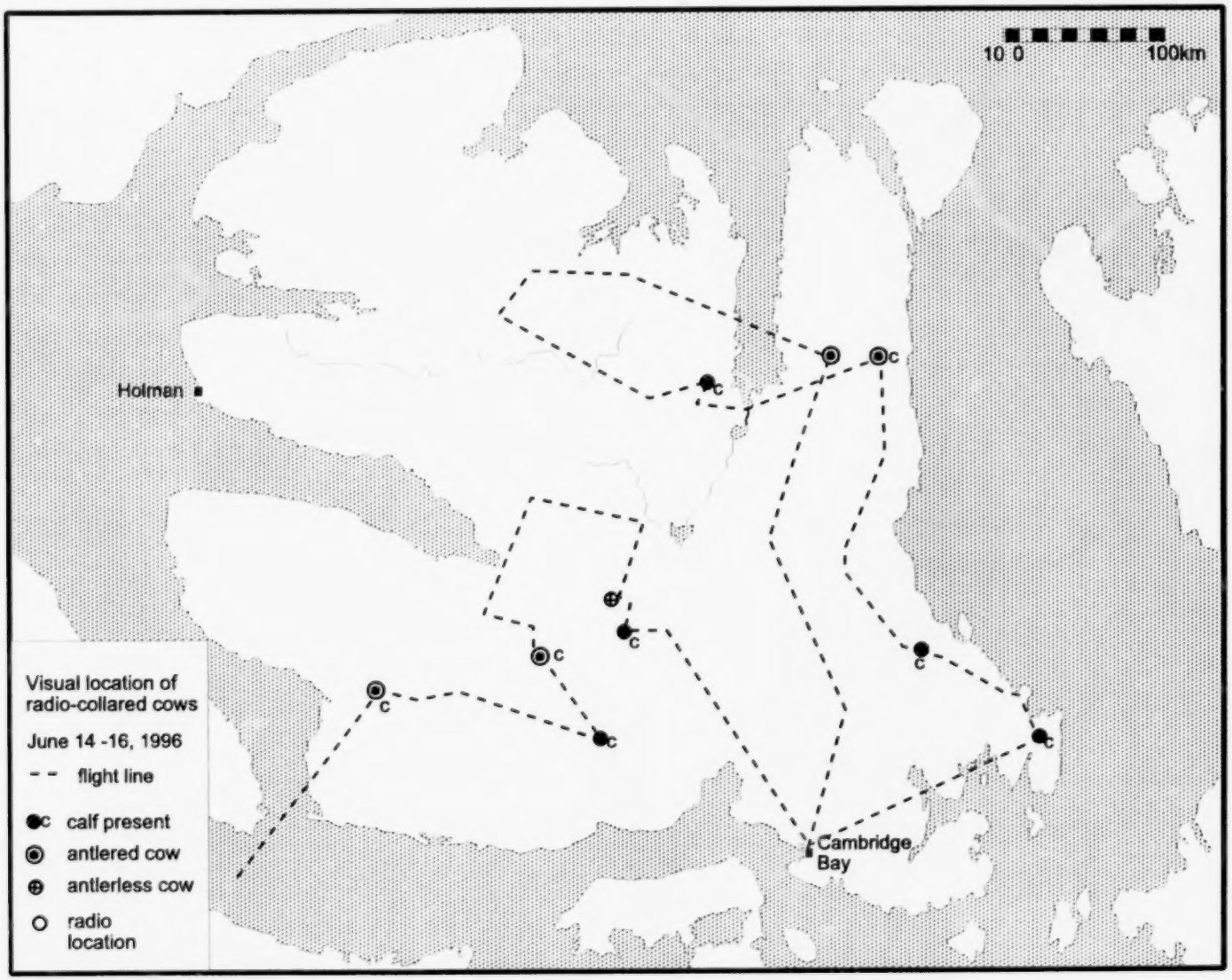

Figure 60. Victoria Island radio-telemetry calving survey, June 14-16, 1996, Nishi in prep.

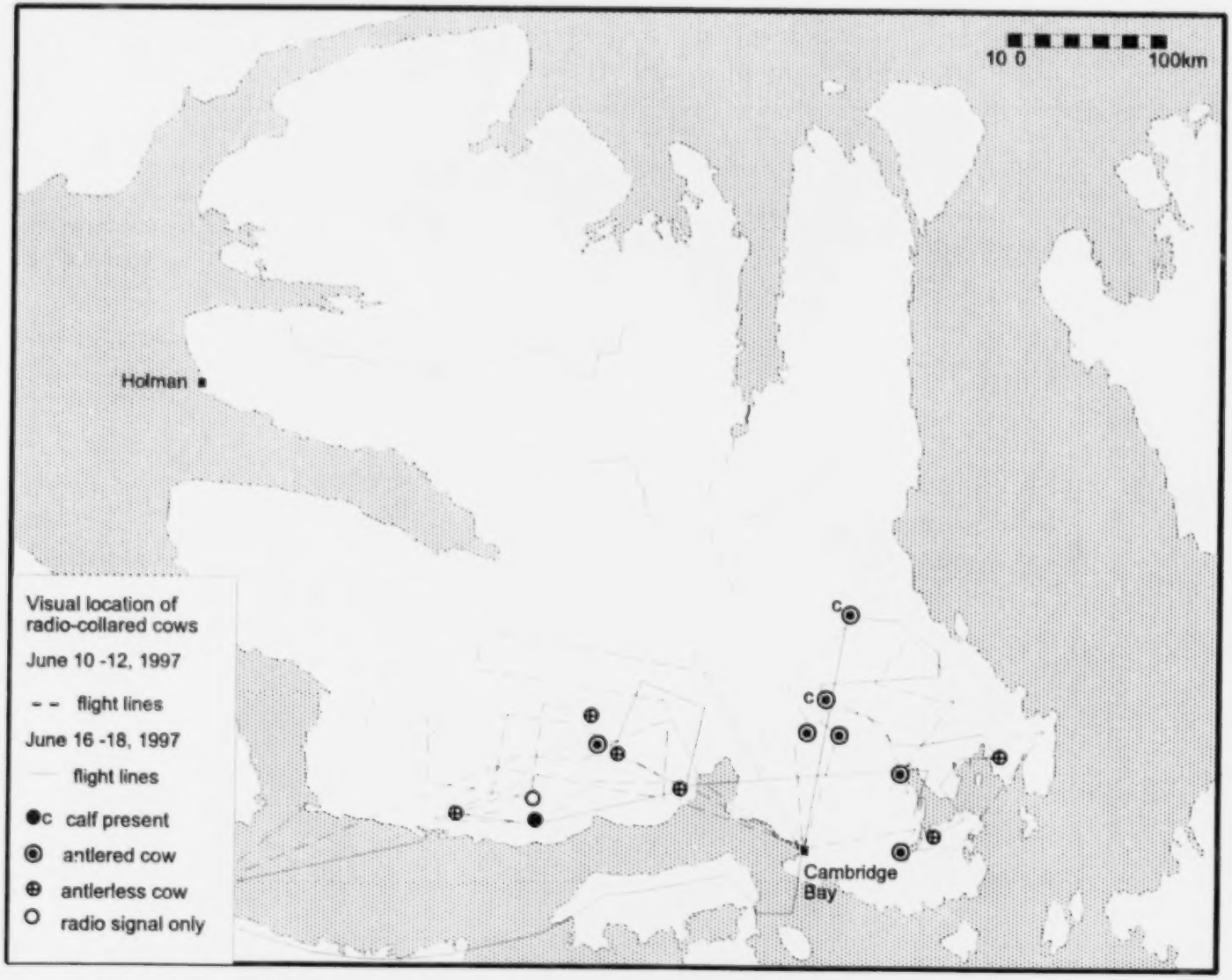

Figure 61. Victoria Island radio-telemetry calving survey, June 10-18, 1997, Nishi in prep.

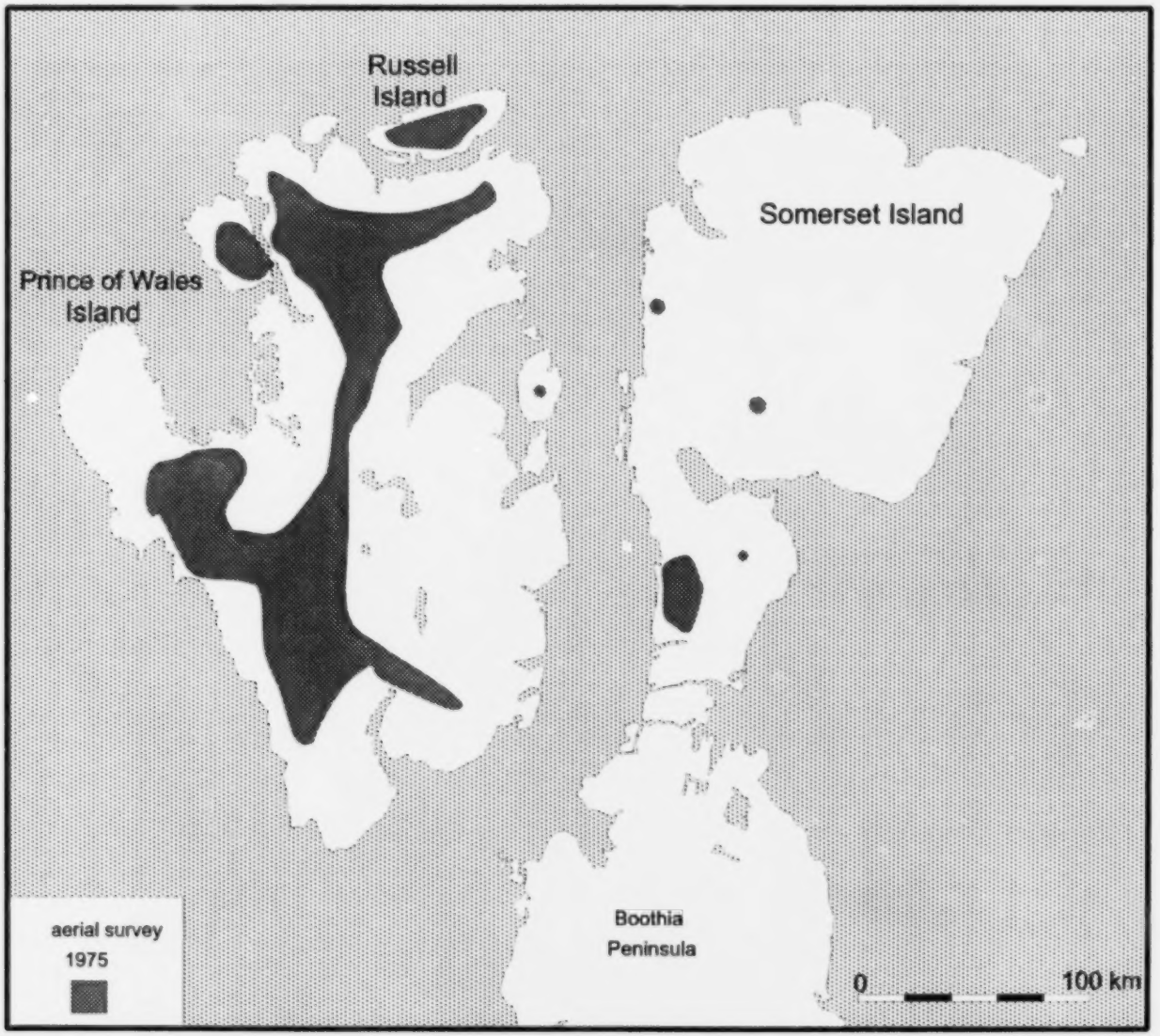

Figure 62. Prince of Wales, Russell and Somerset islands cow-calf locations, 1975.

Landscape and ecology: **characterized as having varied topography, rolling sparsely vegetated herbaceous and bare ground tundra.**

16. a) Pre-calving surveys (May to early June): none.

16. b) Calving areas (early to mid- June, newborn calves seen)

1974 and 1975 **Fischer and Duncan 1976**

Aerial surveys were conducted to determine abundance and distribution as baseline information for the environmental assessment for a proposed pipeline. The report has maps with flight lines and caribou sightings.

The surveys covered Somerset Island on 3-9 June 1974 and most of the 62 caribou counted on transect were in the rugged uplands along the west coast north of Stanwell-Fletcher Lake, however, the report does not indicate if any were cows with newborn calves (Figure 63). For Prince of Wales Island, the survey maps for 14 June 1974 do not give cow-calf sightings and the report does not distinguish whether the proportion of calves is from the June or July survey.

Maps for the 23-24 June 1975 survey of Somerset Island revealed concentrations of cow-calf pairs along the southwest coast, particularly south of Stanwell-Fletcher Lake. The authors suggested it as a calving area [but later experience suggests that those cows may have calved on Boothia Peninsula and moved north onto Somerset Island]. On Prince of Wales Island, survey maps for 15-22 June 1975 showed mostly cows and calves on the west especially the Arrowsmith Plains (Figure 64). On 16 June 1975, 23 calves were among the 123 caribou counted on Russell Island.

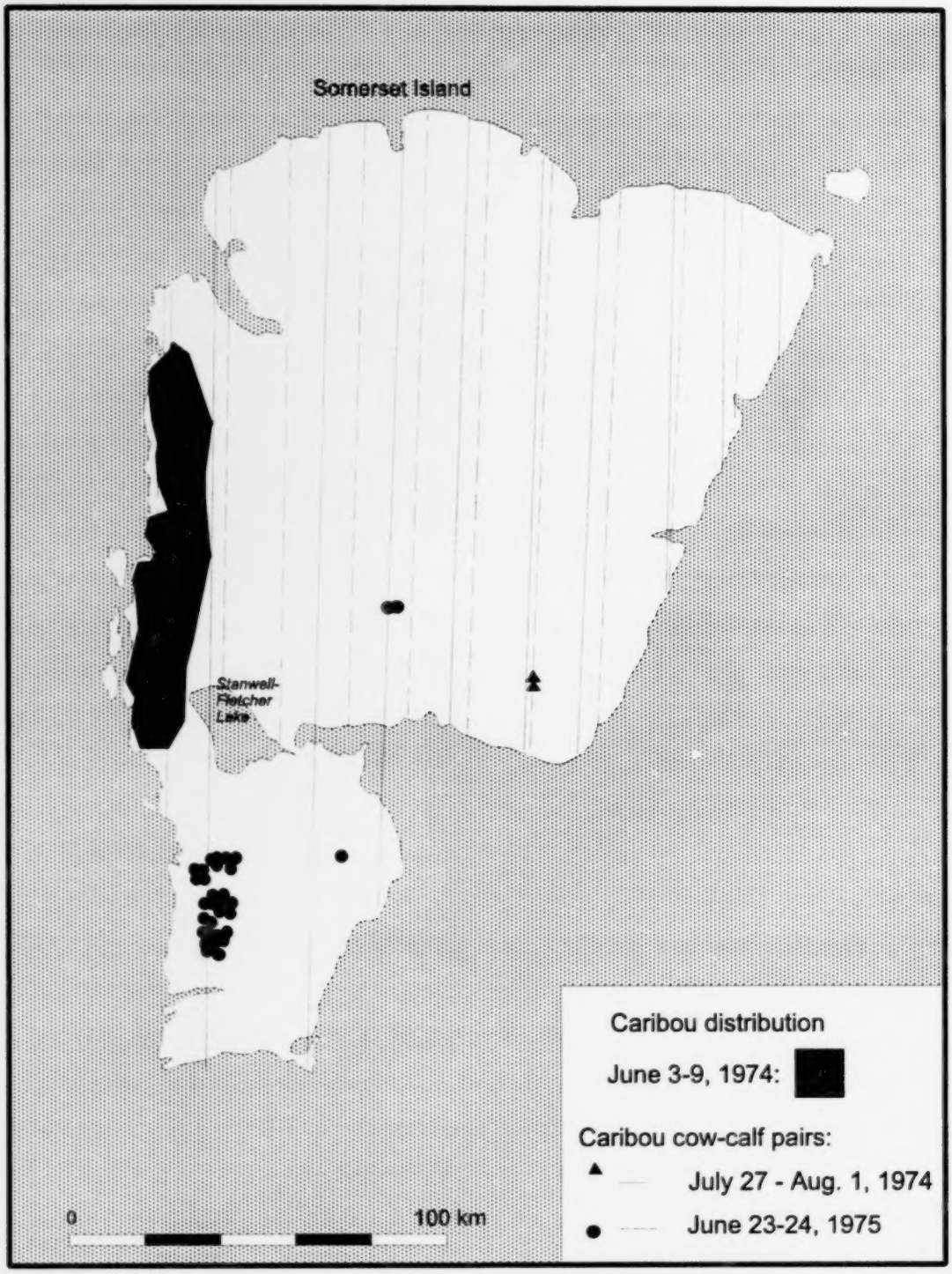

Figure 63. Somerset Island survey area, July - August, 1974 and June, 1975, Fischer and Duncan 1976.

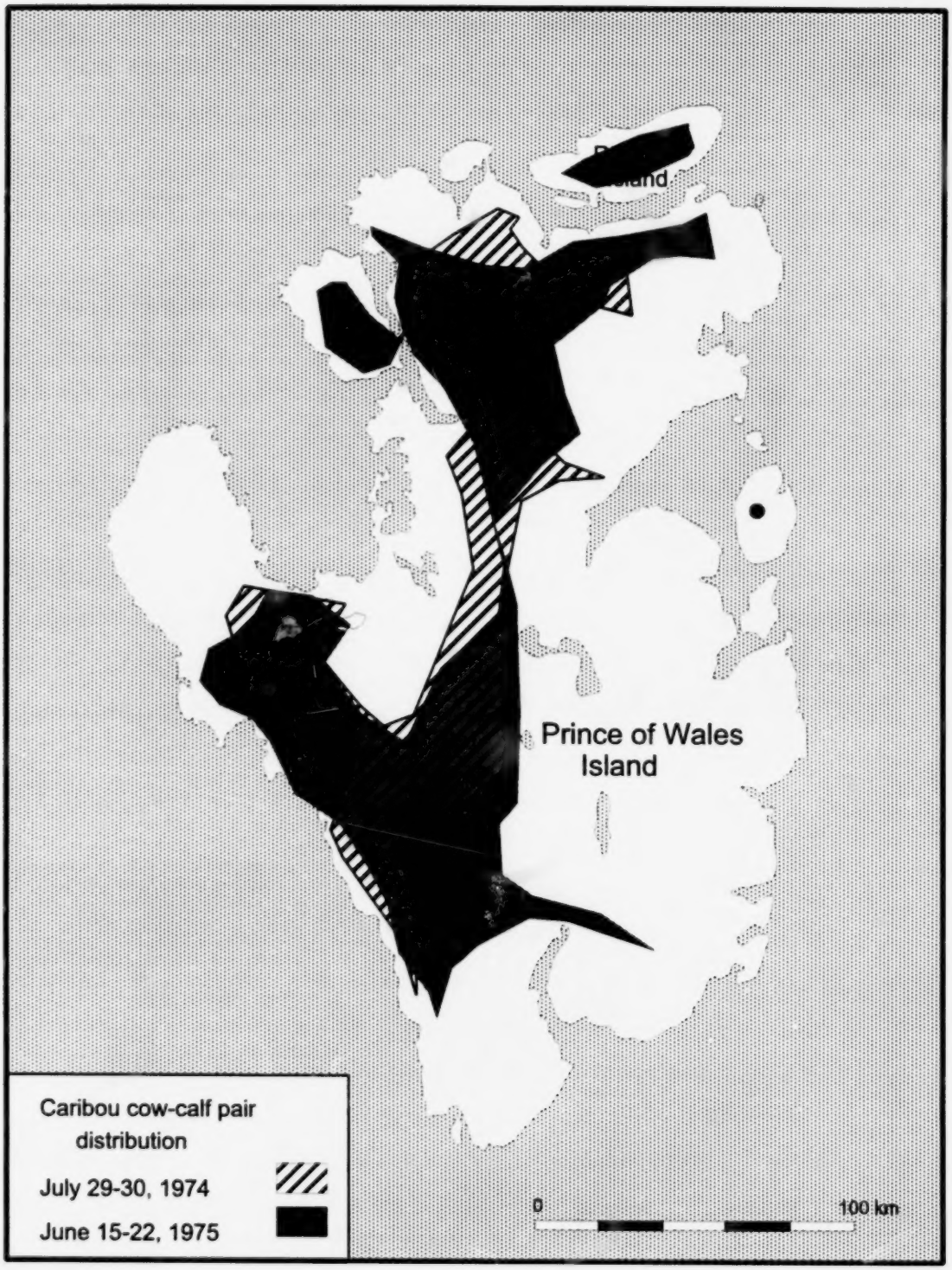

Figure 64. Prince of Wales and Russell islands survey area, July, 1974 and June, 1975, Fischer and Duncan 1976.

1977 and 1978 **Miller and Gunn 1979**

Unsystematic surveys (12 - 18 June 1977) were flown to document caribou trails on the sea-ice to determine inter-island movements. Cows and calves appeared on the north and east coasts of Prince of Wales Island after the 3rd week in June 1977, suggesting that they had calved on Somerset Island. In 1978, most cows seen on northern Prince of Wales Island in the 3rd week of June had not calved, but did so later. Other cows had crossed from Somerset Island in May and calved on Mt. Clarendon. The report does not have maps with flight lines or caribou sightings.

1977, 1978 and 1980 **Miller *et al.* 1982**

Calving in 1977-1980 was during the 3rd week of June (18 June ± 3 days) and authors reported that the caribou "show affinities for specific calving areas". No flight lines or distribution maps were included in the report. They identified the northwest coastal area (Mt. Clarendon) as a calving area (F.L. Miller pers. comm.) based on observations of cows with newborn calves in the area

16. c) Post-calving surveys (late June/early July)

1974 and 1975 **Fischer and Duncan 1976**

A systematic aerial survey was conducted on Somerset Island from 27 July to 1 August 1974 (Figure 63).

On Prince of Wales Island, an aerial survey was conducted on 29-30 July 1974 (Figure 64). The distribution of caribou in 1974 was found to be similar to the distribution observed during the 1975 survey (15-22 June).

1980 July 12-22 **Gunn and Decker 1984**

Systematic transect surveys of Prince of Wales, Somerset and Russell islands were flown to estimate numbers and distribution of Peary caribou on 12-22 July 1980. Caribou were mostly distributed on west and northwest Prince of Wales Island with three areas of relatively high concentration of cow-calf groups: the northwest peninsula (Mt. Clarendon), the broad drainage running southwest from Arabella Bay to Smith Bay, and the rolling terrain south of Baring Channel.

On Somerset Island, cow-calf groups were concentrated on the coastal plain north of Creswell Bay, south of the bay and along the southwest coast (Figure 65) which is consistent with the pattern seen in 1975 (Figure 60).

On Russell Island, caribou were distributed over the whole island, although there were fewer in the north-central area.

1995 July 21 - August 3 **Gunn and Dragon 1998**

A systematic transect survey was conducted in 1995 to confirm reports of the absence of caribou on Prince of Wales and Somerset islands. The survey methods were similar to those used in 1980. Only seven caribou were seen, five on Prince of Wales Island and two on Somerset Island, and none on the satellite islands. The number of animals estimated represents a 99.6% reduction from 1980. No calves were observed and of the seven caribou seen, five were cows and two were bulls (Figure 66).

17. Boothia Peninsula - west

Calving ground identification: The calving ground on northwest Boothia Peninsula (Wrottesley Inlet) was delineated from systematic aerial surveys

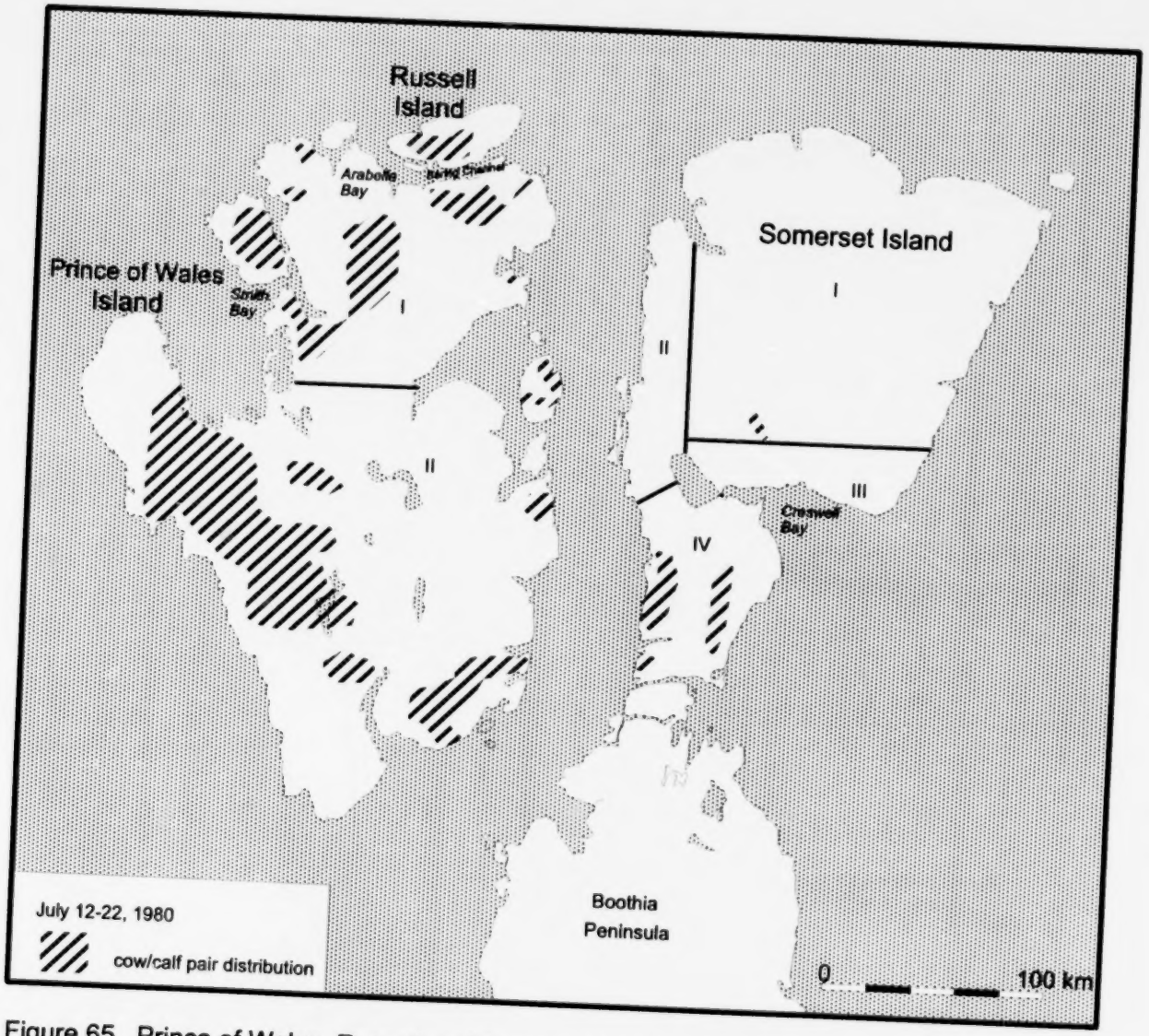

Figure 65. Prince of Wales, Russell and Somerset islands survey area, July 12-22, 1980, Gunn and Decker 1984.

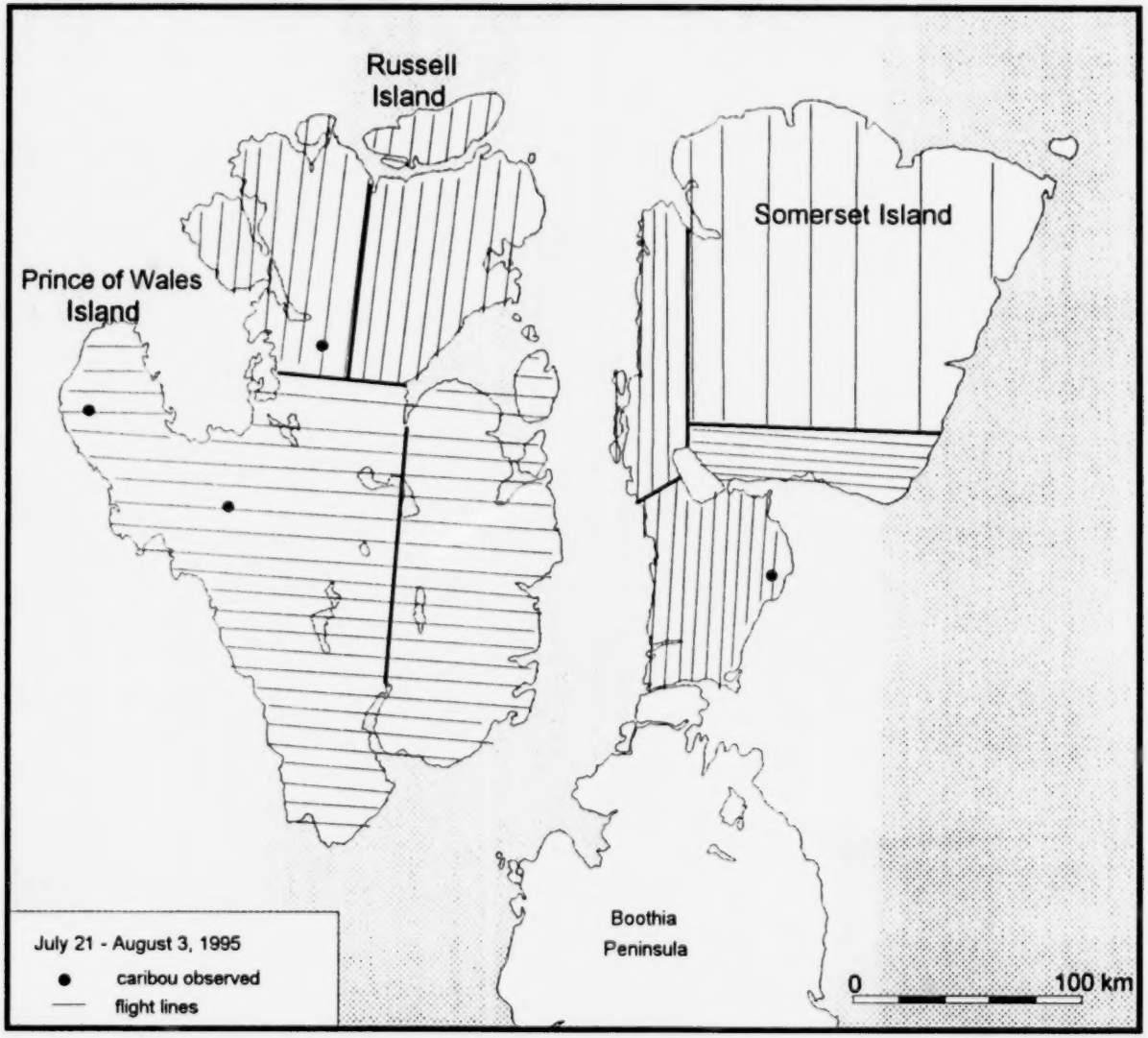

Figure 66. Prince of Wales, Russell and Somerset islands survey area, July 21-August 3, 1995, Gunn and Dragon 1998.

during calving in 1975 and 1985 (Figure 67). Observations of calving cows in 1974 and of satellite-collared cows in June 1991 and 1992 overlapped with the area delineated in 1975 and 1985.

Landscape and ecology: hilly and rugged with sparsely vegetated herbaceous and bare ground tundra.

17. a) Pre-calving surveys (May to early June): none

17. b) Calving areas (early to mid- June, newborn calves seen)

1974 May- June, 1975 June **Fischer and Duncan 1976**

The surveys were to collect baseline information of wildlife abundance and distribution along the proposed route of a gas pipeline. The authors flew transect surveys in June 1974 and 1975 to determine seasonal numbers and distribution of caribou on Boothia Peninsula and from those surveys, the authors noted the distribution of cow-calf pairs to be similar in 1974 and 1975. Cow-calf concentrations "...were consistently observed in the northwest between Pasley Bay and Wrottesley Inlet..." (Figures 68 and 69).

In 1974, the entire peninsula was divided into three areas but only one was covered during surveys approximately 10 days apart (7-9 June and 19-20 June) which limits interpretation as caribou almost certainly moved between the areas. Calving was underway during the 7-9 June 1974 survey when one cow-calf pair was seen in the Wrottesley Lowlands, southeast of the inlet.

From 5 to 12 June 1975, the entire Boothia Peninsula was surveyed which allowed the delineation of a calving ground and the 40 cow-calf pairs seen were all on the northwest in the vicinity of Wrottesley Inlet (Figure 69).

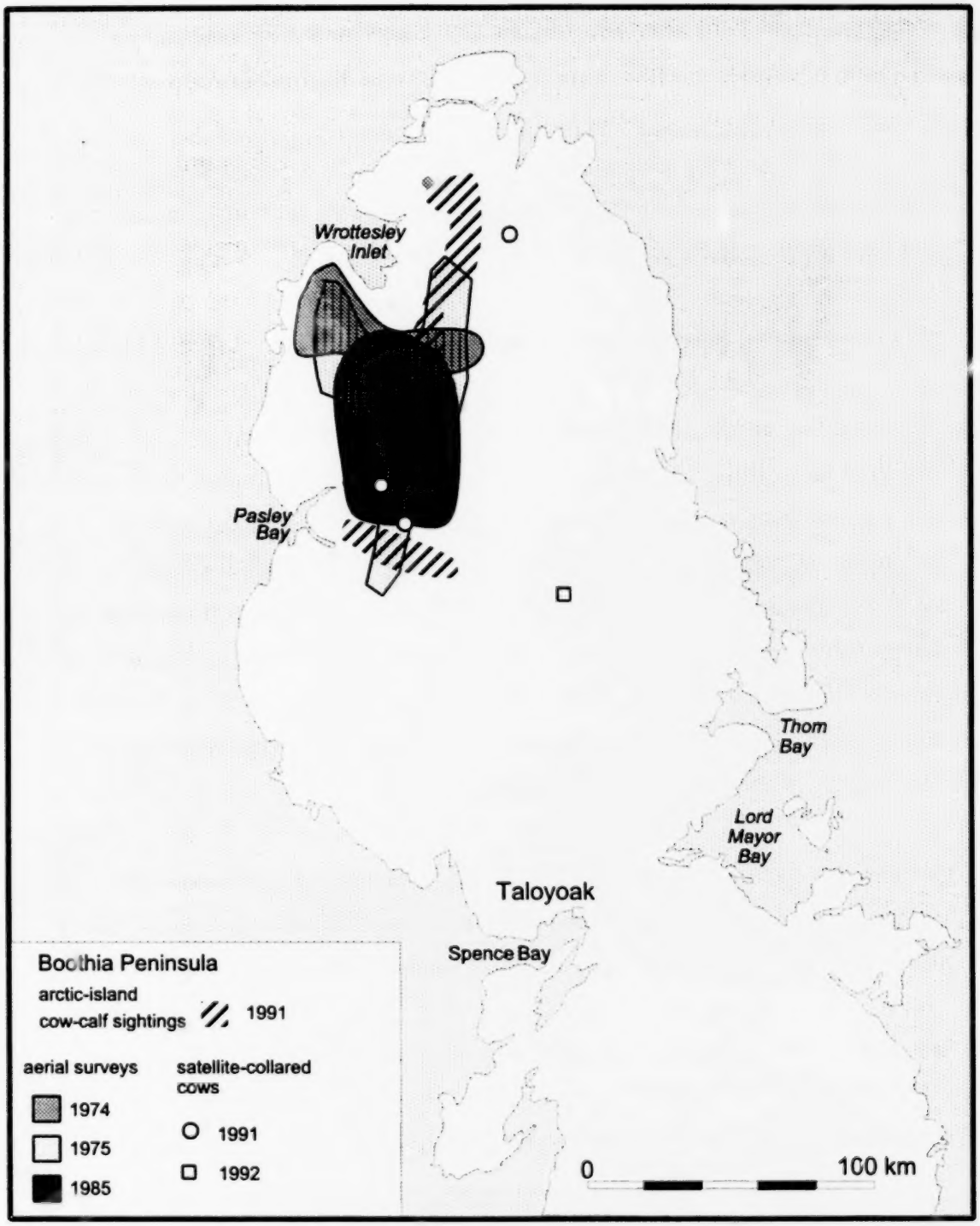

Figure 67. West Boothia Peninsula cow-calf sightings, 1974 - 1992.

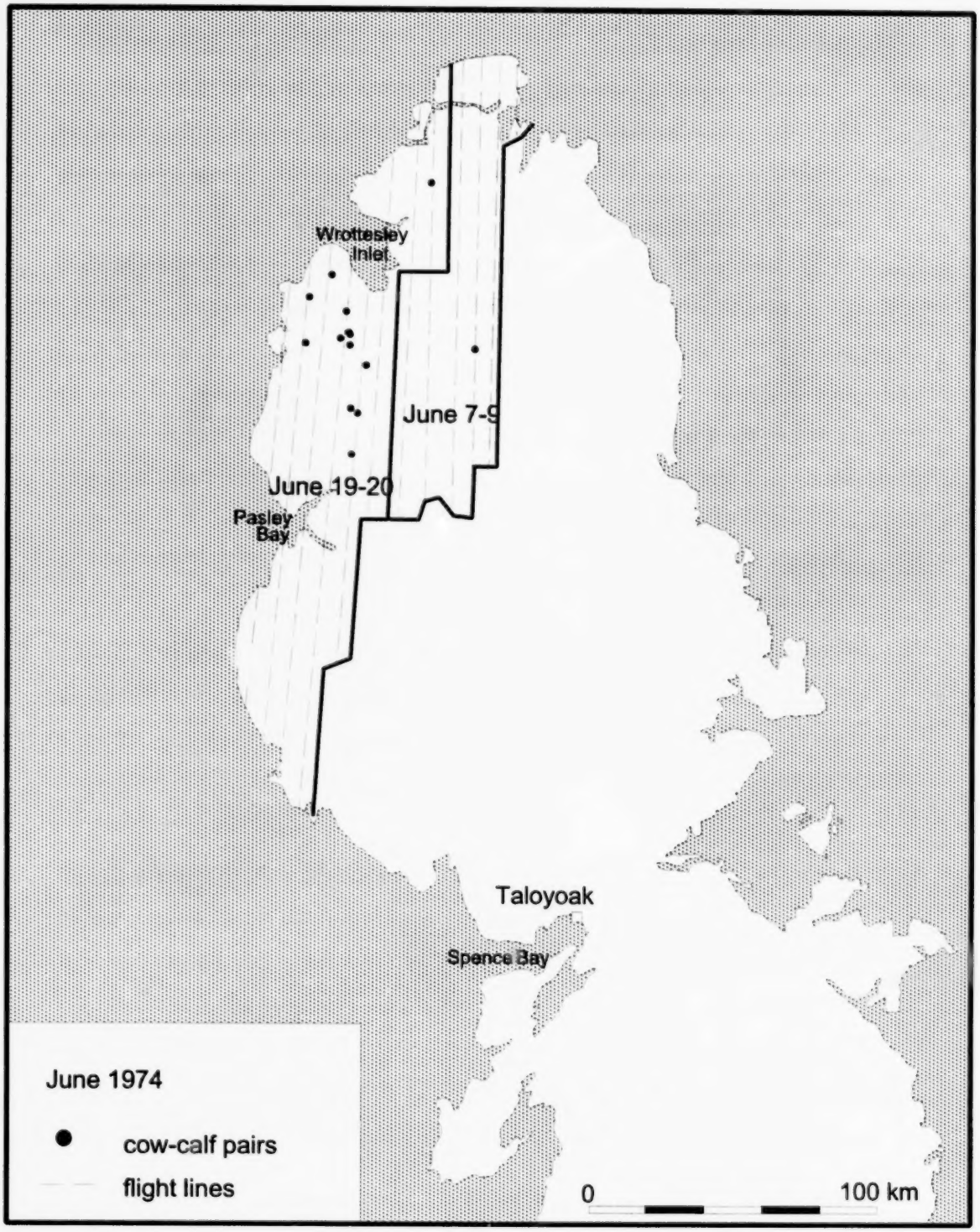

Figure 68. West Boothia Peninsula survey area, June 1974, Fischer and Duncan 1976.

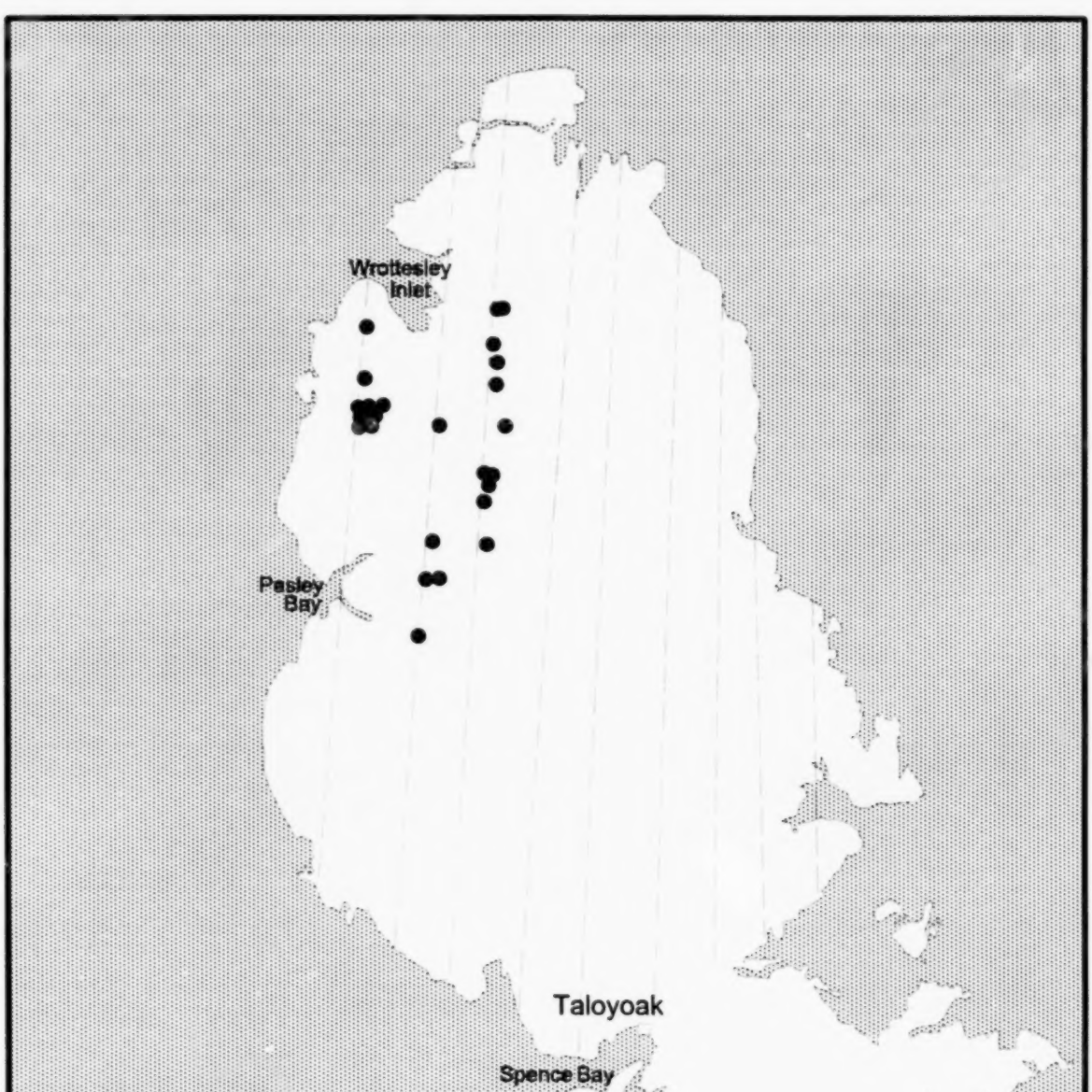

Figure 69. Boothia Peninsula survey area, June 5-12, 1975, Fischer and Duncan 1976.

1985 May 31 - June 13 **Gunn and Ashevak 1990**

A systematic strip transect survey for caribou was conducted over Boothia Peninsula. The first newborn calves were seen on 3 June 1985. Caribou with calves were localized in two of four areas of higher density and were found more among the rock outcrops than on the valley floor. The area of calving was delimited based on observations of cow-calf groups east and northeast of Pasley Bay (Figure 70) and along the east side of the uplands bordering the Wrottesley River.

1991 - 1993 **Gunn and Fournier in prep. a.**

Six cows were fitted with satellite collars in March 1991 to track their movements on Boothia Peninsula. Three were arctic-island and three were barren-ground caribou. In June 1991-93, the cows were visually located to determine if they were pregnant (hard antlers), had calved or were probably non-breeders (no antlers). The visual check was to find out which June locations were calving locations as not all non-breeding cows reach the calving grounds. We also noted if other cows were calving in the immediate vicinity although we did not attempt to delineate calving ground boundaries.

On 13 June 1991, two arctic-island caribou had calved and the third was unseen in fog but was close to one of the other cows on northwest Boothia. The cows that had calved had other cow-calf pairs in their vicinity (Figures 20 and 21). On 15 June 1992, the only surviving collared arctic-island caribou was on central Boothia but was not seen (Figure 22). The sample sizes were small but the calving of the arctic-island caribou in 1991 and 1992 on northwest Boothia was similar to previous findings. No collared arctic-island cows were surviving in 1993.

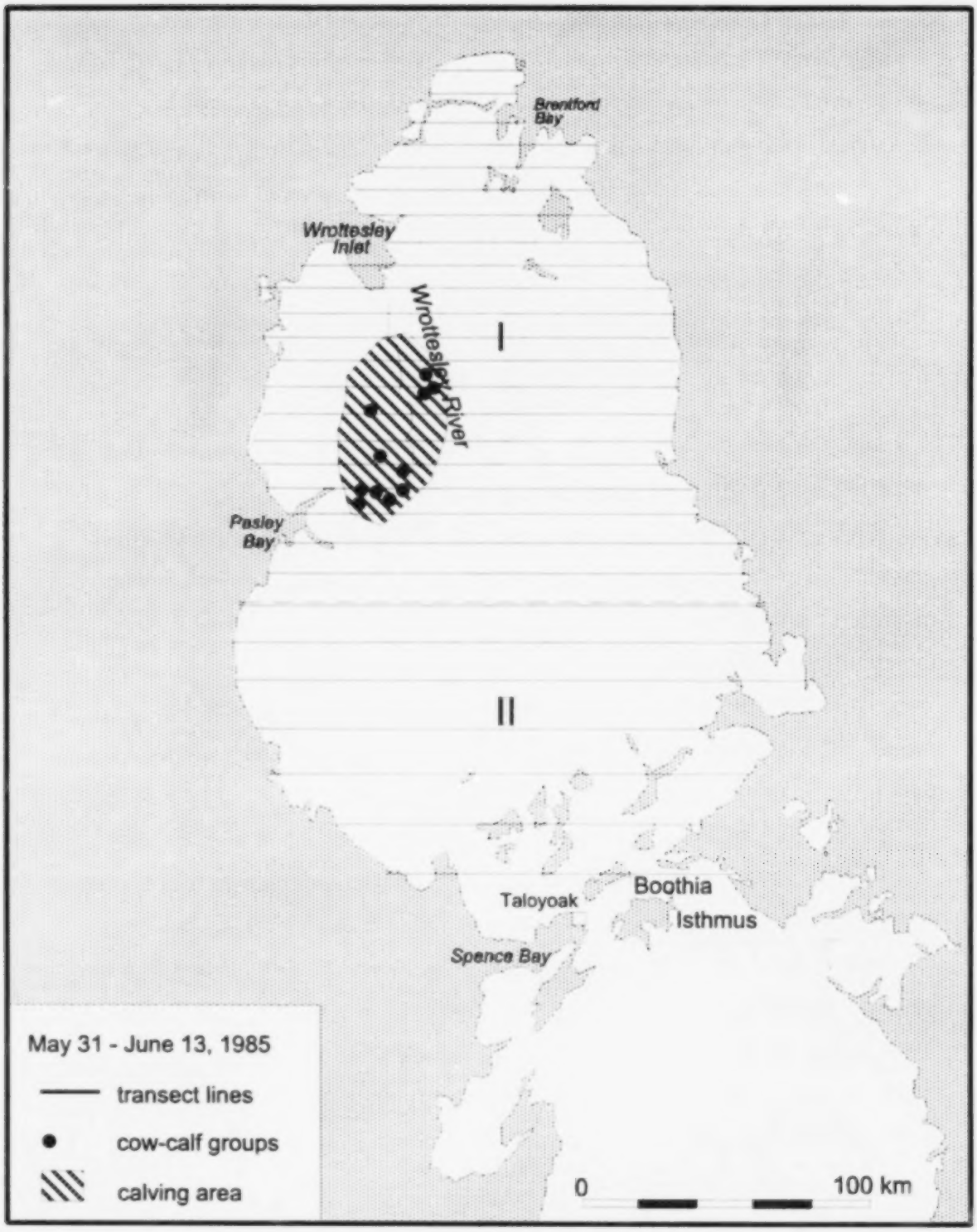

Figure 70. Boothia Peninsula survey area, May 31 - June 13, 1985, Gunn and Ashevak 1990.

17. c) Post-calving surveys (late June/early July)

1975 June 28 - July 2 **Fischer and Duncan 1976**

In late June and early July 1975, many caribou were still concentrated on the northwest part of Boothia Peninsula between Pasley Bay and Wrottesley Inlet and north of Wrottesley Inlet, but large numbers were also observed in the north-central portion of the peninsula. One large post-calving group of 352 animals, mostly cow-calf pairs, was 45 km southeast of Wrottesley Inlet on central Boothia Peninsula (Figure 71).

18. Queen Elizabeth Islands

Calving ground identification: Information on calving distribution is scarce as most aerial surveys were later winter and post-calving. Post-calving observations suggested that calving occurred on Prince Patrick, and southern and eastern Melville islands. Observations of dye-marked caribou (1972-76) documented inter-island seasonal migrations which included pre-calving migration from Prince Patrick Island to Melville Island. The information was not sufficient to distinguish between calving and post-calving areas but eastern Melville Island was identified as, at least, a calving area (Figure 72). Devon Island (Grinnell Peninsula) has been identified as a calving area (S. Akeeagok pers. comm.)

Landscape and ecology: Melville Island is characterized as hilly with bare ground tundra and sparse vegetation.

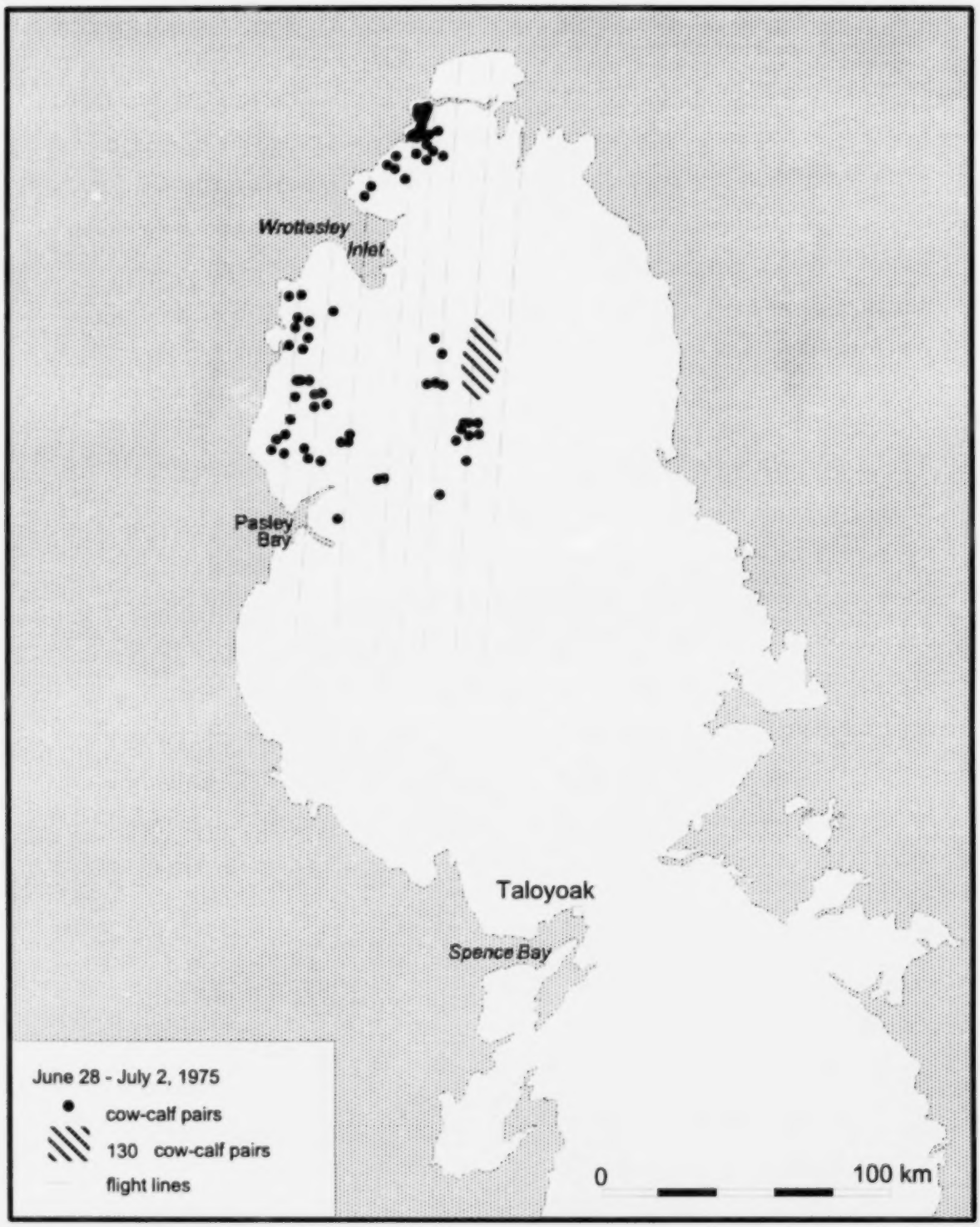

Figure 71. Boothia Peninsula survey area, June 28 - July 2, 1975, Fischer and Duncan 1976.

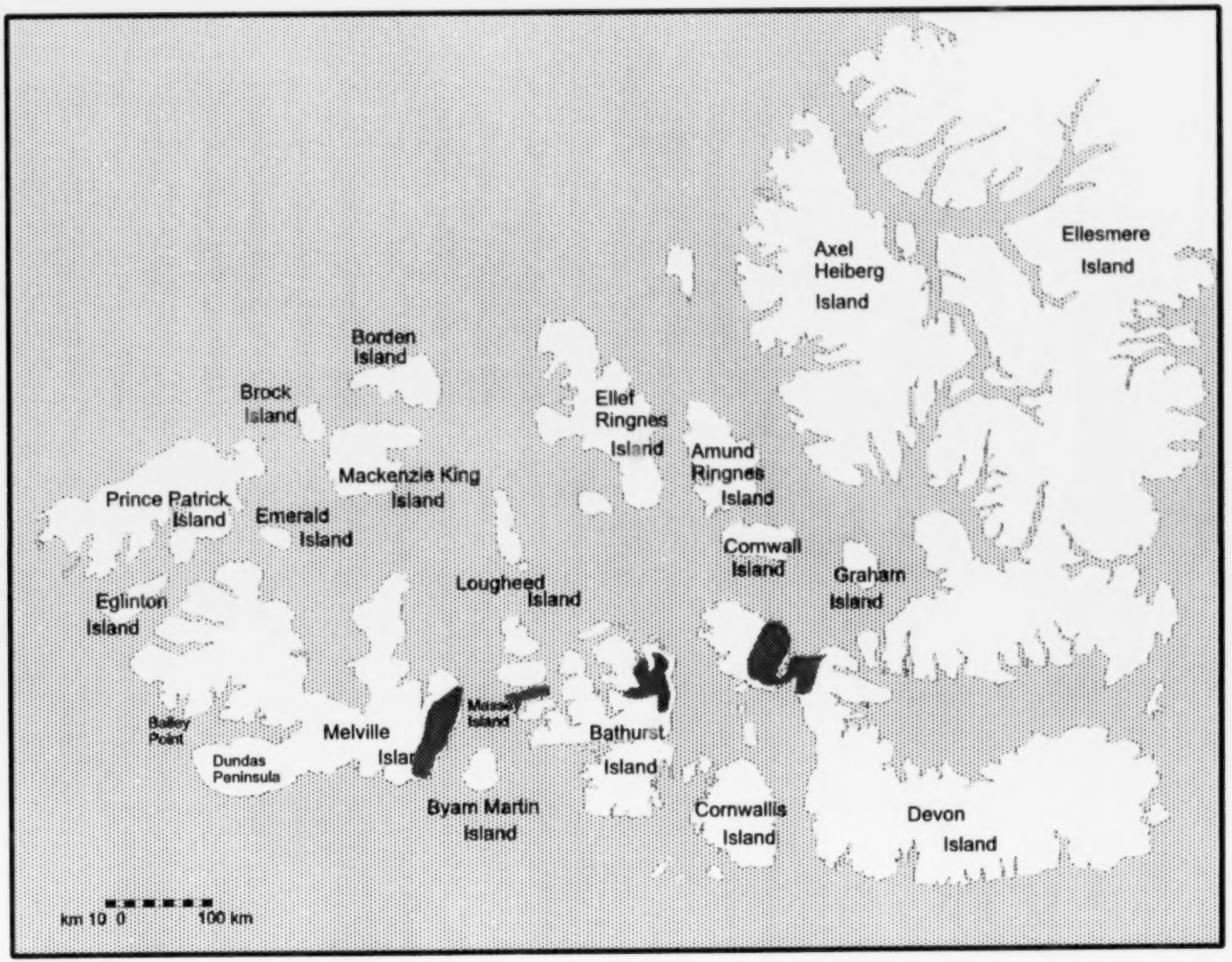

Figure 72. Queen Elizabeth islands calving areas.

18. a) Pre-calving surveys (May to early June): none

18. b) Calving areas (early to mid- June, newborn calves seen)

Devon Island: Grinnell Peninsula has been identified as a calving area (S. Akeeagok pers. comm.).

1961 June **Tener 1963**

Systematic surveys were flown to determine Peary caribou and muskox numbers and distribution on the Queen Elizabeth Islands. The surveys were conducted from June to August so information on calving distribution is limited to the few islands covered in June: Cornwallis, Devon and Little Cornwallis islands. On these islands, only 17 caribou were seen and none were calves when surveyed between 10 and 17 June 1961.

1974 June 8-29 **Miller *et al.* 1977a, Miller *et al.* 1977b**

Unsystematic aerial searches for dye-sprayed caribou were flown to document seasonal inter-island movements between Prince Patrick, Eglinton and Melville islands. Searches between June 8 to 29 recorded 260 caribou but the report only mentions one newborn calf on western Melville Island. The results when added to the estimates from aerial surveys are the basis for the statement: "In general Peary caribou on Melville move to coastal areas mainly of the Dundas Peninsula and eastern Melville at and/or shortly after calving in late May or early June." However, some caribou are born and summer on Prince Patrick Island and during July surveys in 1973-74, calves were seen as described in the following section on post-calving.

18. c) Post-calving surveys (late June/early July, Aug.)

1961 July **Tener 1963**

Systematic aerial surveys revealed calves on all the islands surveyed: Emerald Island - 4 of 11 caribou were calves (July 24); Melville Island - 153 of 769 caribou were calves (July 8-22); Prince Patrick Island - 28 of 138 caribou were calves (July 23, 24); Eglinton Island - 4 of 13 caribou were calves (July 24); Borden Island - 22 of 100 caribou were calves (August 17); Mackenzie King Island - 24 of 111 were calves (August 17); Ellef Ringnes Island -3 of 21 were calves (August 14); Amund Ringnes Island - 4 of 16 were calves (August 15); Lougheed Island -19 of 86 were calves (August 18); Cornwall Island - 11 of 37 were calves (August 15).

1972 - 1974 July - August **Miller *et al.*1977a**

Systematic aerial surveys revealed that Peary caribou had declined between 1961 and 1973 and then further declined during the 1973/74 winter which was severe on Bathurst and eastern Melville Islands. After the die-off, few calves were seen. The authors mapped caribou group sightings, but not cows with calves separately, and no flight lines.

Melville Island had the largest number of Peary caribou, and sightings during the aerial surveys led the authors to comment on the Dundas Peninsula as "...the area of primary importance for rearing of caribou calves on Melville Island" (Figure 73). On Prince Patrick Island during the survey from 28 July to 21 August 1973, 33 of 329 caribou seen were calves, and 33 of 469 caribou seen on 18-25 July 1974 were calves. On Eglinton Island, no calves were seen in the 1972 and 1973 summers and one calf in 1974. On Byam Martin Island in July 1973, there were nine calves among 79 caribou seen and no calves seen in 1974.

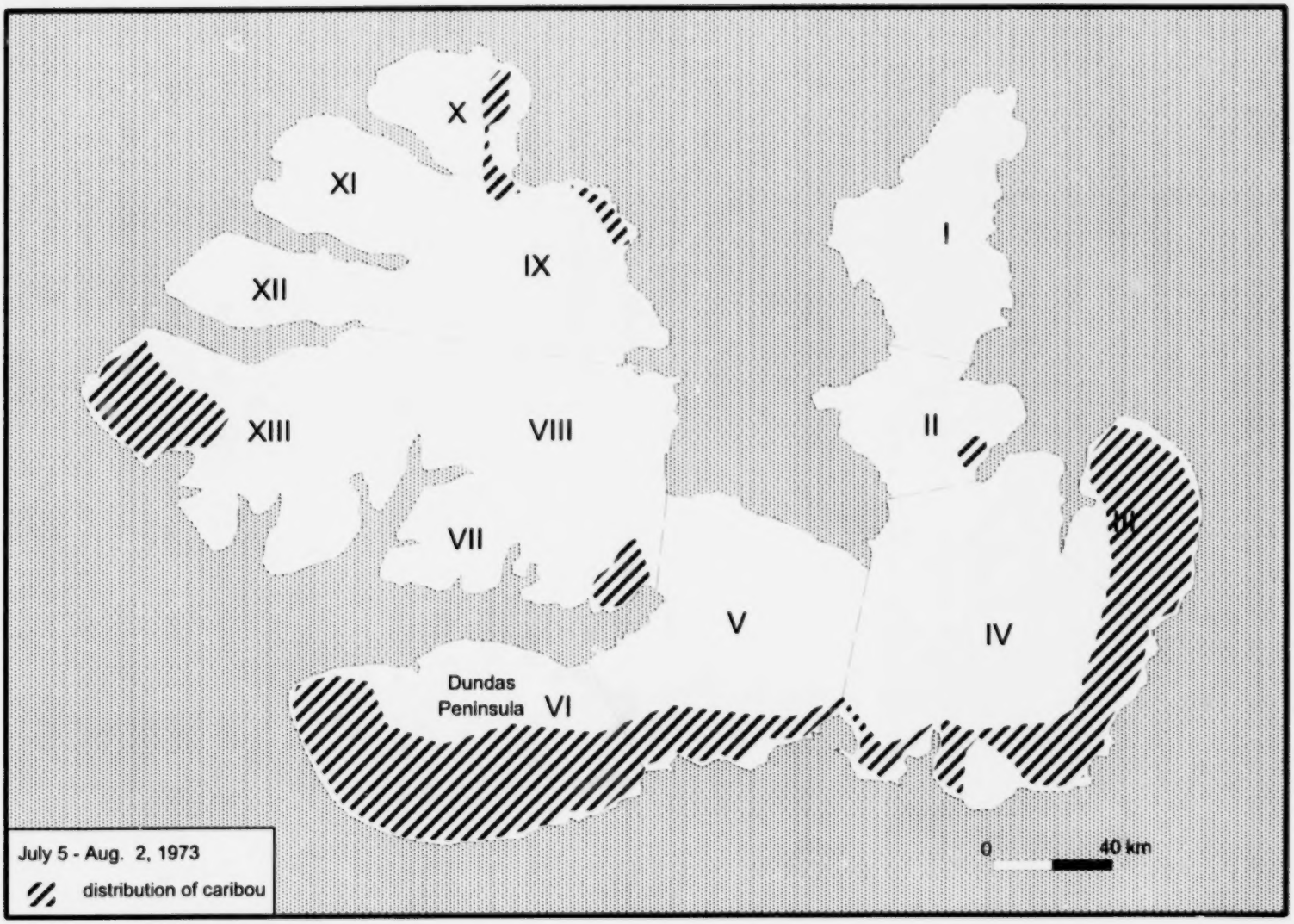

Figure 73. Melville Island survey area, July 5 - August 2, 1973, Miller *et al.* 1977.

1974 and 1975 **Fischer and Duncan 1976**

The authors surveyed eastern Melville Island on 1 July 1975 and observed 40 calves in 158 caribou seen. They noted that caribou were located within 15 km of the coast (Figure 74).

Cornwallis Island was surveyed on 28 July 1974 and late June 1975. During a spot check on 24 June 1974, two calves were seen on western Cornwallis Island out of a total of eight caribou. During the July 1974 survey, the authors saw six caribou. Four of the animals were located in the northwest part of the island and more than 10 km inland, while the other two were centrally located. Only one of these animals was a calf. There were no caribou seen in June 1975. The authors commented on a possible movement of caribou between Cornwallis and Bathurst islands (Miller and Russell 1975). The report includes maps of caribou locations along transect lines.

1977 July 11-13 **McLaren *et al.* 1977**

The purpose of this study was to conduct an aerial survey of southeast Melville Island to determine distribution and abundance of caribou and muskox. Groups of caribou appeared randomly distributed with no significant difference in frequency between coastal areas and inland areas. Seven of the 26 caribou seen on transect were calves. The report contains a map of caribou locations but does not show calf locations (Figure 75).

1987 July 1-22 **Miller 1988**

Systematic transect surveys were conducted on Melville and Byam Martin islands to determine caribou distribution. The author commented that densities on Melville Island were highest on the northeastern and northwestern strata.

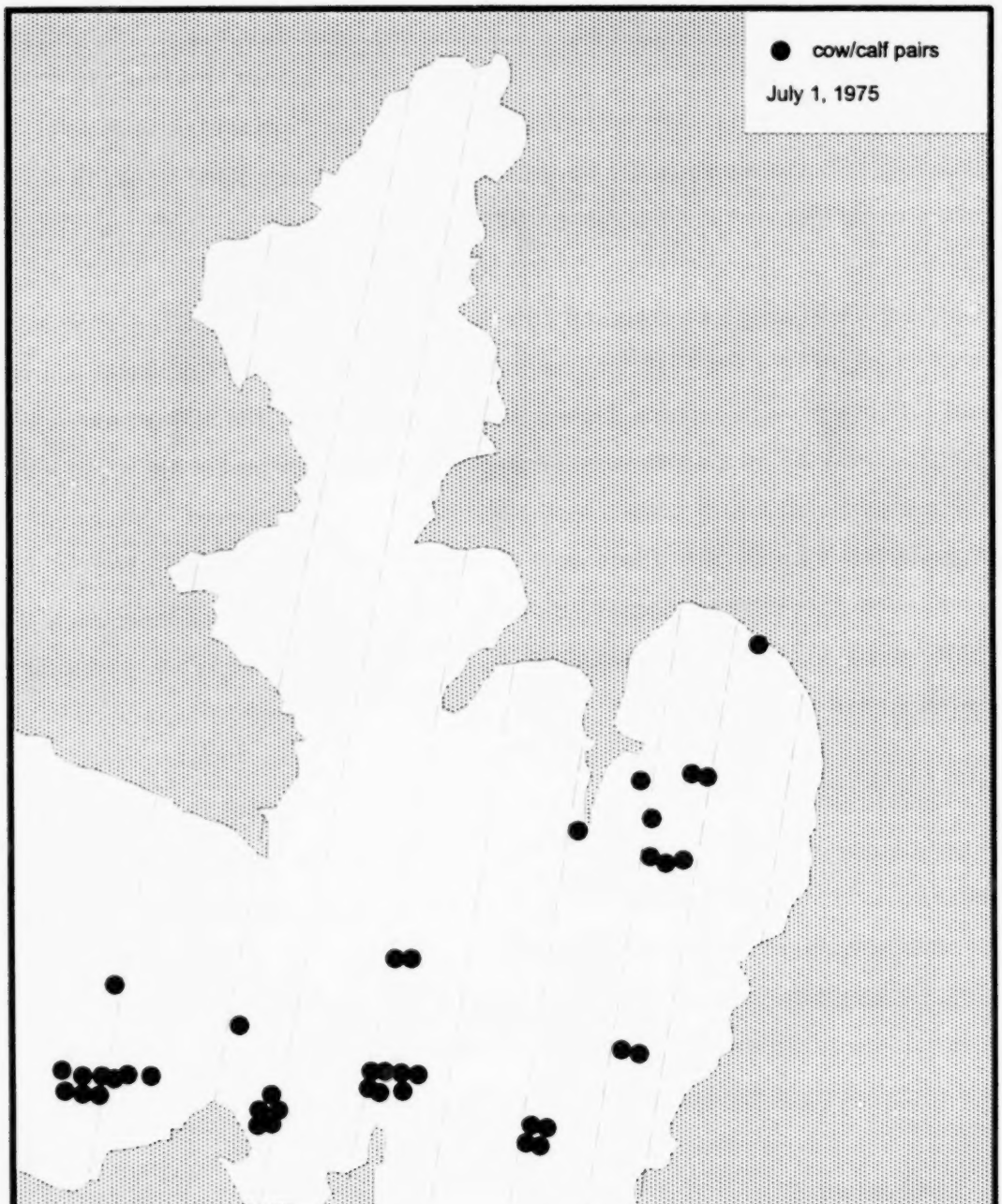

Figure 74. Eastern Melville Island survey area, Fischer and Duncan, 1976.

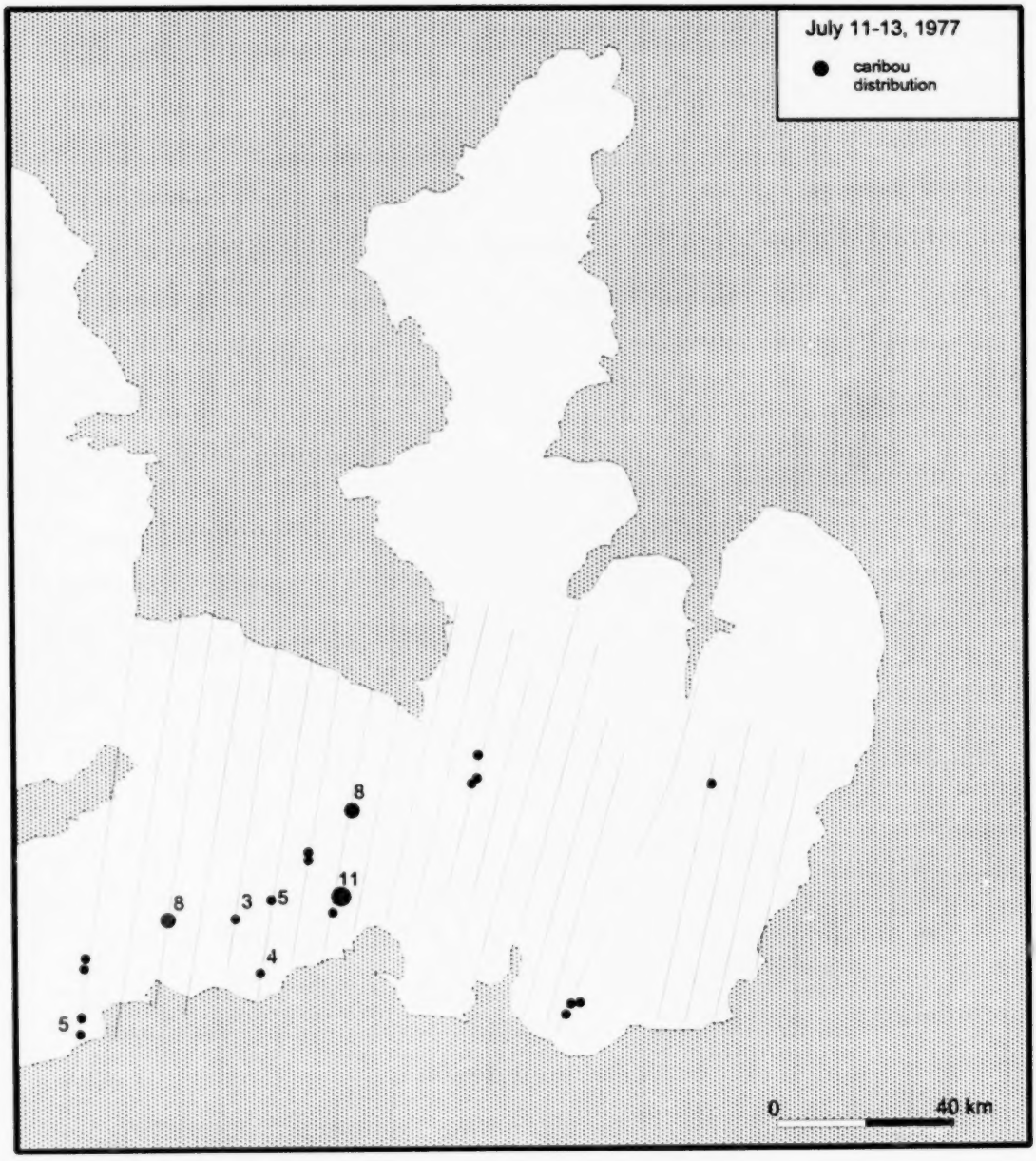

Figure 75. Eastern Melville Island survey area, July 11-13, 1977, McLaren *et al.* 1977.

The proportion of calves was also noted to be higher in the east. Calves were also observed on Byam Martin Island.

1997 June 29 - July 24 **Gunn and Dragon in prep.**

Prince Patrick, Melville and Bathurst islands were surveyed for abundance of caribou (Figure 76). Two cow-calf pairs were observed; one on Mackenzie King Island and one on Lougheed Island.

19. Bathurst Island

Calving ground identification: Calving grounds on northeast Bathurst Island and Massey Island have been identified and delineated (Figure 77) based on unsystematic aerial surveys (1990-93) and satellite telemetry (1988 - 95).

Landscape and ecology: lowlands of bare ground tundra and sparse vegetation.

19. a) Pre-calving surveys (May to early June): none.

19. b) Calving areas (early to mid- June, newborn calves seen)

Local knowledge indicates that caribou move to the northeast to calve, and summer in the north. Caribou were reported to migrate north at or before calving in June and return south from August to October (Thomas and Miller 1981).

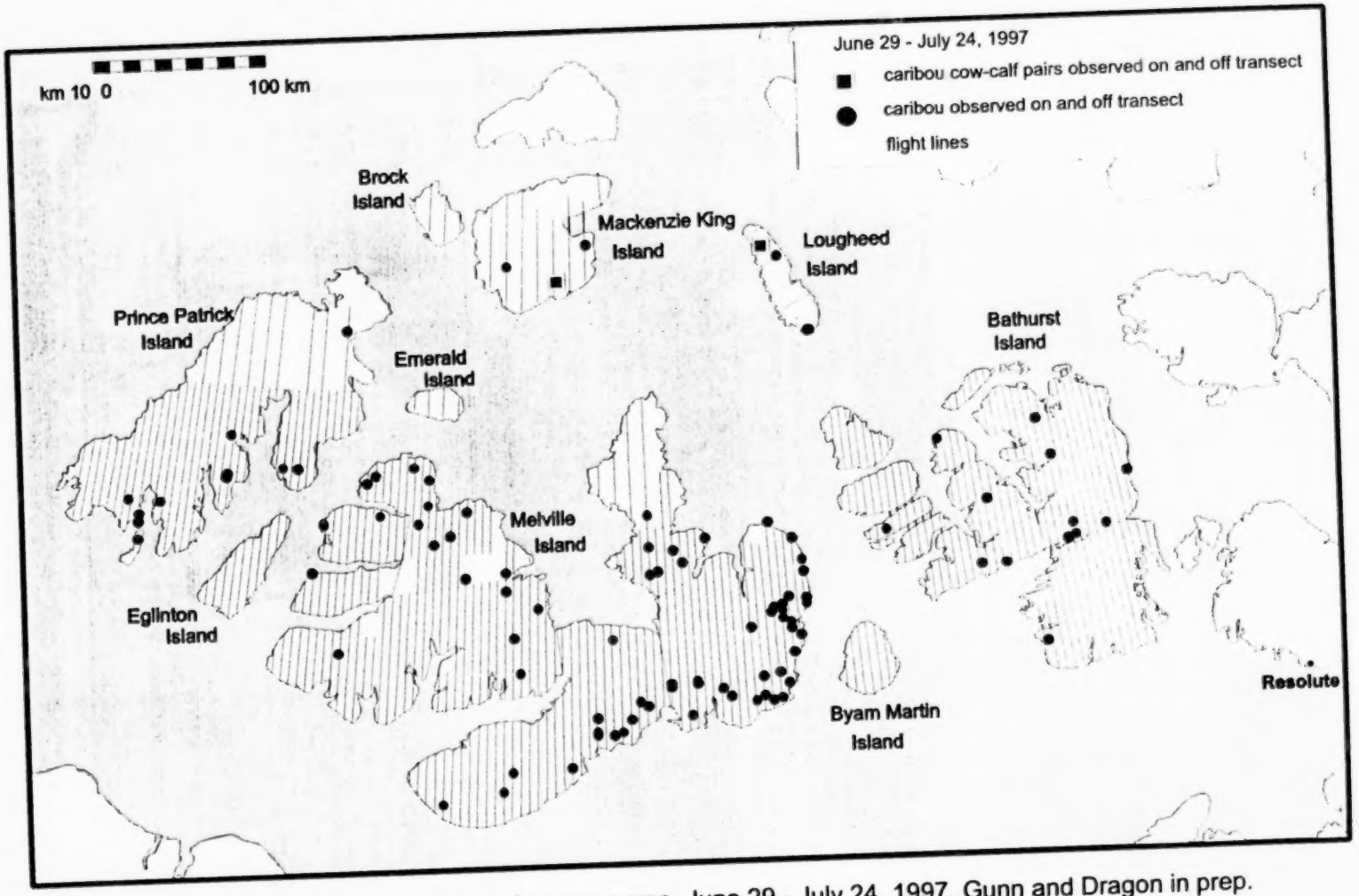

Figure 76. Western Queen Elizabeth islands survey area, June 29 - July 24, 1997, Gunn and Dragon in prep.

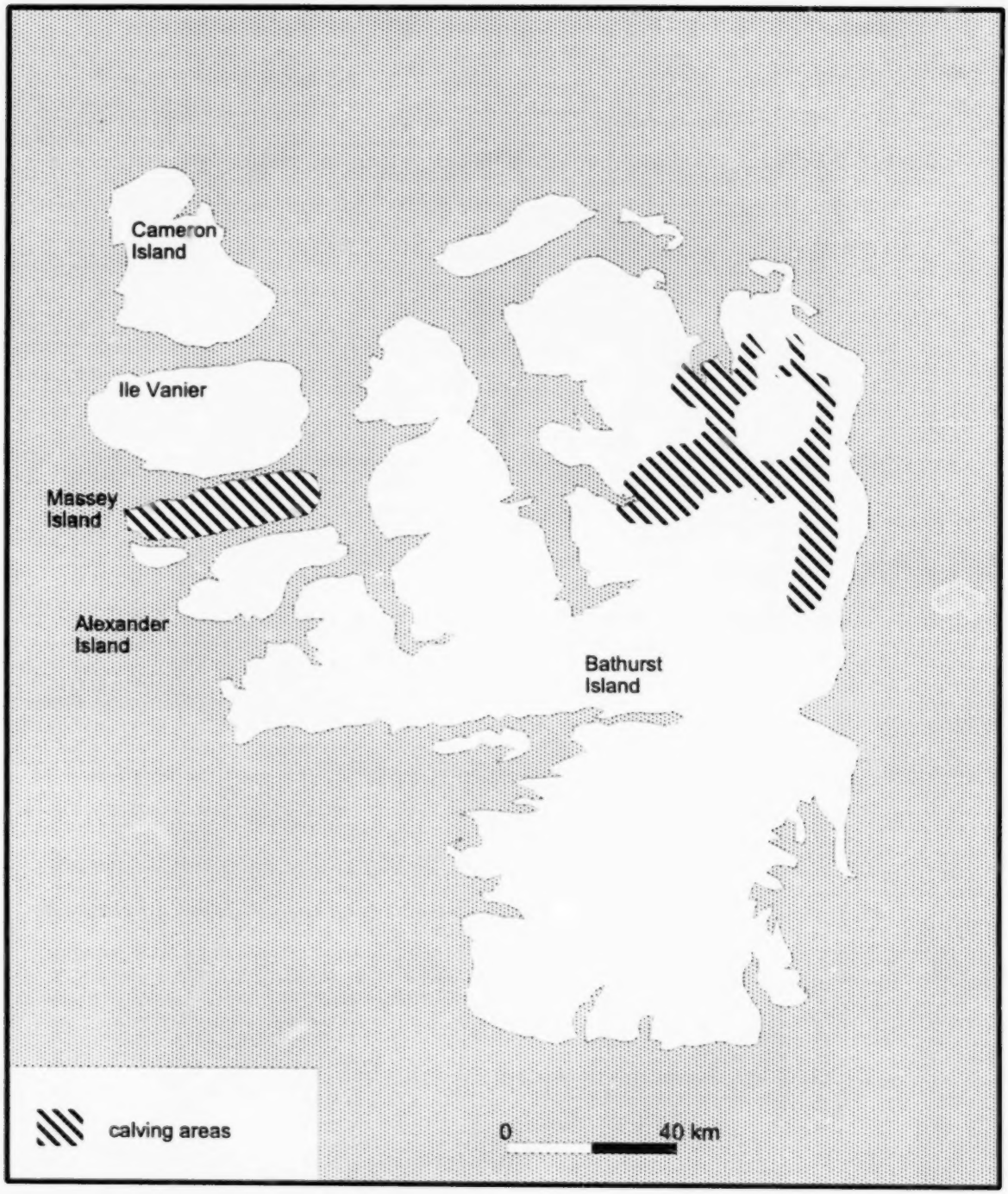

Figure 77. Bathurst Island complex calving areas, F.L. Miller, pers. comm.

1992 June, July 5-8 **Miller 1994**

Unsystematic aerial searches were made of the Bathurst Island complex to determine numbers and distribution of caribou. The author reports that calving peaked during the second and third weeks of June and continued into July in 1992. It was also noted that calving occurred two weeks earlier than in 1990 and one week earlier than in 1991. Caribou were mainly observed on interior areas in June, shifting to coastal areas in early July. The majority of caribou were observed north of Polar Bear Pass. The study indicated that the calving period on Bathurst Island varied between years from early June to early July.

1996 **F.L. Miller pers. comm.**

In response to Parks Canada's identification of an 'Area of Interest' for a park feasibility study on northern Bathurst Island and an approval of mineral and energy resource assessment studies within the 'Area of Interest' by the Minister of Indian and Northern Affairs Canada (INAC), a calving area was defined on the northeastern part of the island.

19. c) Post-calving surveys (late June/early July)

1961 June-July **Tener 1963**

19, 27, 28 June: During aerial surveys, the majority of caribou including calves were observed in the northeast portion of island within one mile of the coast. A map of the strata was not included in the report.

1, 3, 7 July: Surveys indicated summer distribution as "ranging over the northern part of the island ".

1974 August 25 -26 **Miller *et al.* 1977**

Aerial surveys revealed the distribution of caribou over the northern part of the island. Authors commented that caribou "may prefer low, coastal areas during calving and early summer".

1975 June 25, 26 **Fischer and Duncan 1976**

During these aerial surveys, most caribou were scattered over the northwest half of the island (Figure 78) and calving groups were widely distributed in areas of greater relief. Seventeen of 48 caribou seen were calves. Two percent of observed animals were south of Polar Bear Pass. Authors reported that there was "strong evidence of late winter (1974) movement from southeast Bathurst to Cornwallis Island and to the islands of Barrow St." They reported that Bissett (1968) noted that caribou on Bathurst Island moved northward in the spring from the Dyke Acland Bay and Allison Inlet areas.

1988 July 11-21 **Miller 1989**

An aerial survey was carried out on the Bathurst Island complex to determine numbers and distribution of caribou. Of 467 caribou seen, 169 were calves, and the highest mean density of caribou occurred on Massey Island. The author commented that "breeding females and calves occurred at high rates on Massey Island but no bulls or identifiable juvenile males were seen..." The author ranks stratum II (NE) of Bathurst Island as the most important to Peary caribou from 7 years of data (no figure).

1997 July **Gunn and Dragon in prep.**

Aerial surveys for caribou were conducted on Prince Patrick, Melville and Bathurst islands using the same stratification as Miller *et al.* (1977) (Figure 76). No calves were seen on Bathurst Island.

1998 July 20-30

- cows and calves seen on northeast Bathurst Island (F.L. Miller unpublished).

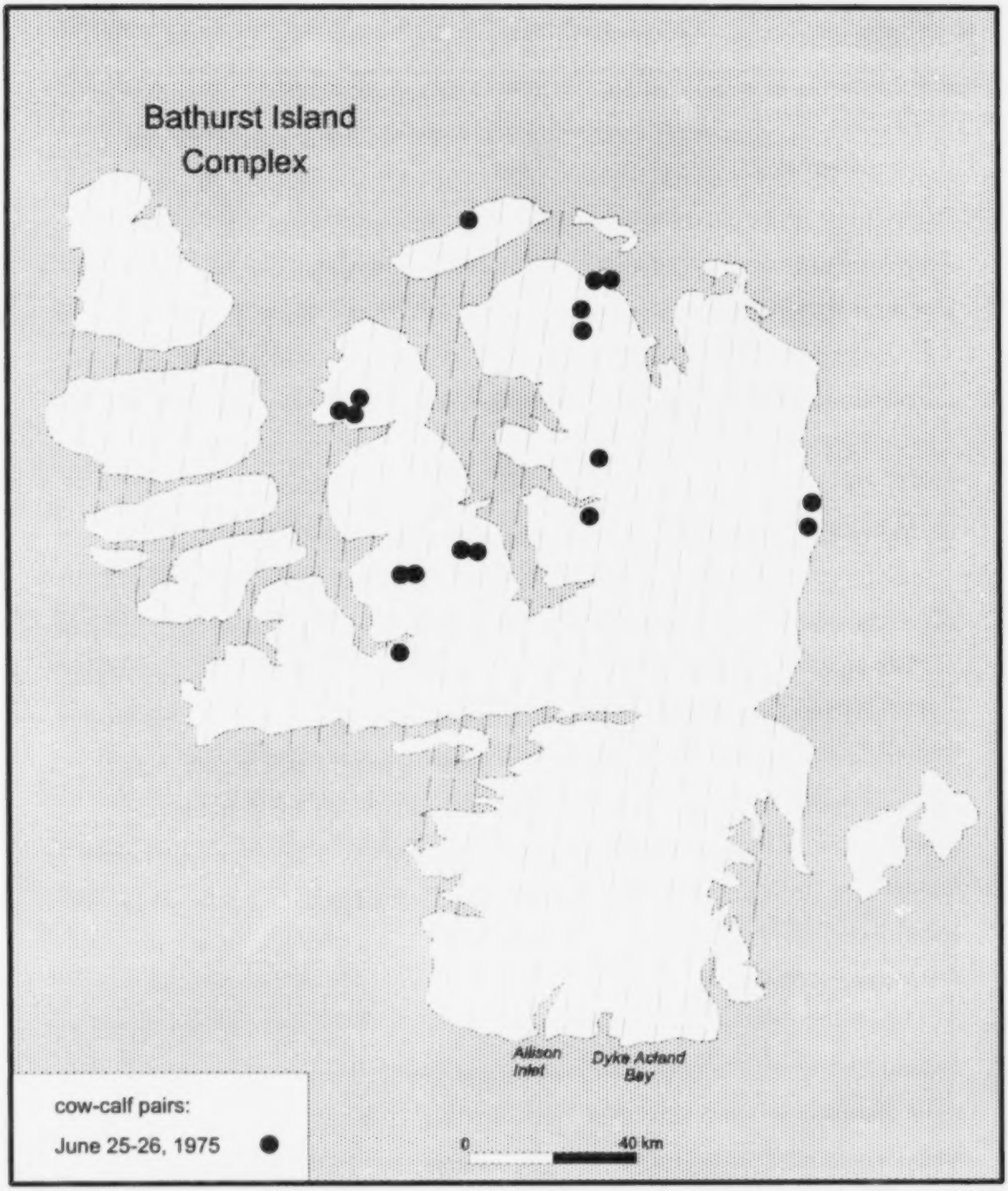

Figure 78. Bathurst Island complex survey area June 25-26 1975, Fischer and Duncan 1976.

20. Ellesmere and Axel Heiberg islands

Calving ground identification: From the information available, we could not identify calving grounds although caribou do calve on the islands. The only reported information on calving distribution was a single calf seen on each island during an unsystematic helicopter survey in June 1995. Three Peary caribou were fitted with satellite collars in the early 1990s but that information was not available at the time of this compilation.

Landscape and ecology: characterized as rugged with bare ground tundra and sparse vegetation.

20. a) Pre-calving surveys: no information available and no surveys known.

20. b) Calving areas (early to mid- June, newborn calves seen):

1995 June 12-21 **Gauthier 1996**

The report details wildlife observations collected during Department of National Defence gravity survey flights over central Ellesmere and Axel Heiberg islands. Nineteen adult caribou and one calf were seen and an additional 18 caribou sightings were reported for Ellesmere Island (Figure 79). Eleven caribou were on Fosheim Peninsula, three at the end of Strathcona Fiord, 11 adults and a calf were on Raanes Peninsula and 12 caribou in the Svendsen Peninsula - Vendom Fiord area.

Twenty-four adult caribou plus one calf were on Axel Heiberg Island. Six groups were observed between Mokka and Skaare fiords, and 3 groups including a calf were located south of Li Fiord on the west coast.

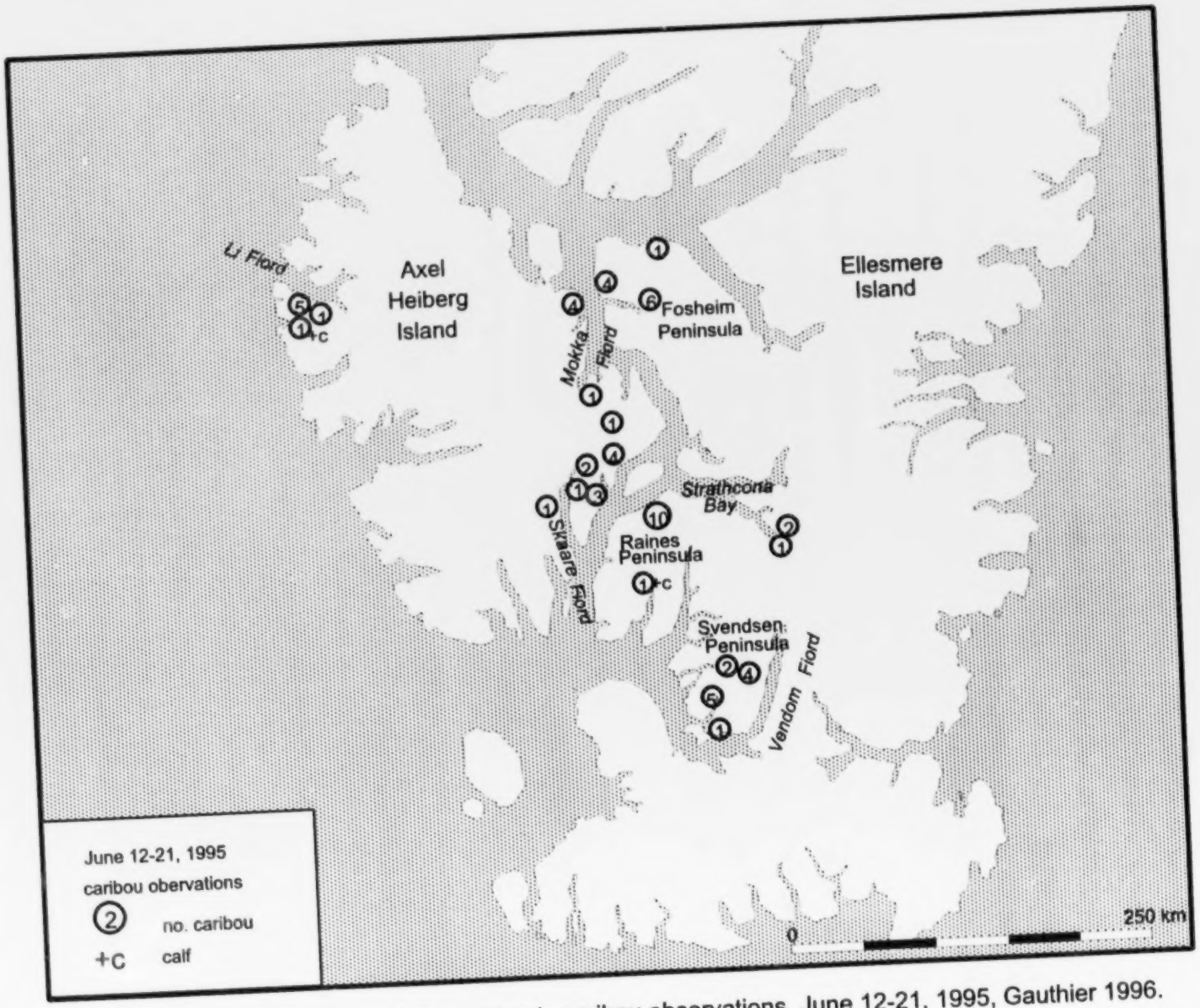

Figure 79. Ellesmere and Axel Heiberg islands caribou observations, June 12-21, 1995, Gauthier 1996.

20. c) Post-calving surveys (late June/early July)

1961 July-August **Tener 1963**

Systematic transect surveys were flown to determine Peary caribou and muskox abundance and distribution but the report does not include mapped flight lines or sightings.

Axel Heiberg: (2,3 August) All 42 caribou including 6 calves were seen at the island's northern tip and along the northwest coast, except for three seen at the head of Whitsunday Bay, Eureka Sound. Coverage was only 3%.

Ellesmere: (30 July and 1, 3-5, 7, 10, 11 August) Operational problems reduced coverage to 2% and large unglaciated areas were not surveyed. The author commented that discontinuous and highly contagious distributions of caribou made population estimates difficult. He observed 37 caribou including 4 calves. Caribou were mostly at low elevations on coastal slopes or in river valleys at the head of bays and fiords including the heads of Baumann and Bay fiords, on Fosheim and Raanes peninsulas, north of Greely Fiord, north of Nansen Sound and on Lake Hazen-Alert plateau.

1973 July 25 **Ross 1973**

During an unsystematic aerial survey of eastern Axel Heiberg Island for muskoxen (Figure 80), the author recorded observations of 32 Peary caribou. The report does not give details and the caribou sightings are not included on the maps accompanying the report.

1989 July 17-23 **Case and Ellsworth 1991**

During an aerial survey of southern Ellesmere Island to estimate muskox and caribou numbers, 45 caribou were seen including 10 calves. Caribou were sparsely distributed near the coast for the five strata surveyed and calves were not distinguished from adult caribou (Figure 81). The report includes a map with flight lines and caribou sightings.

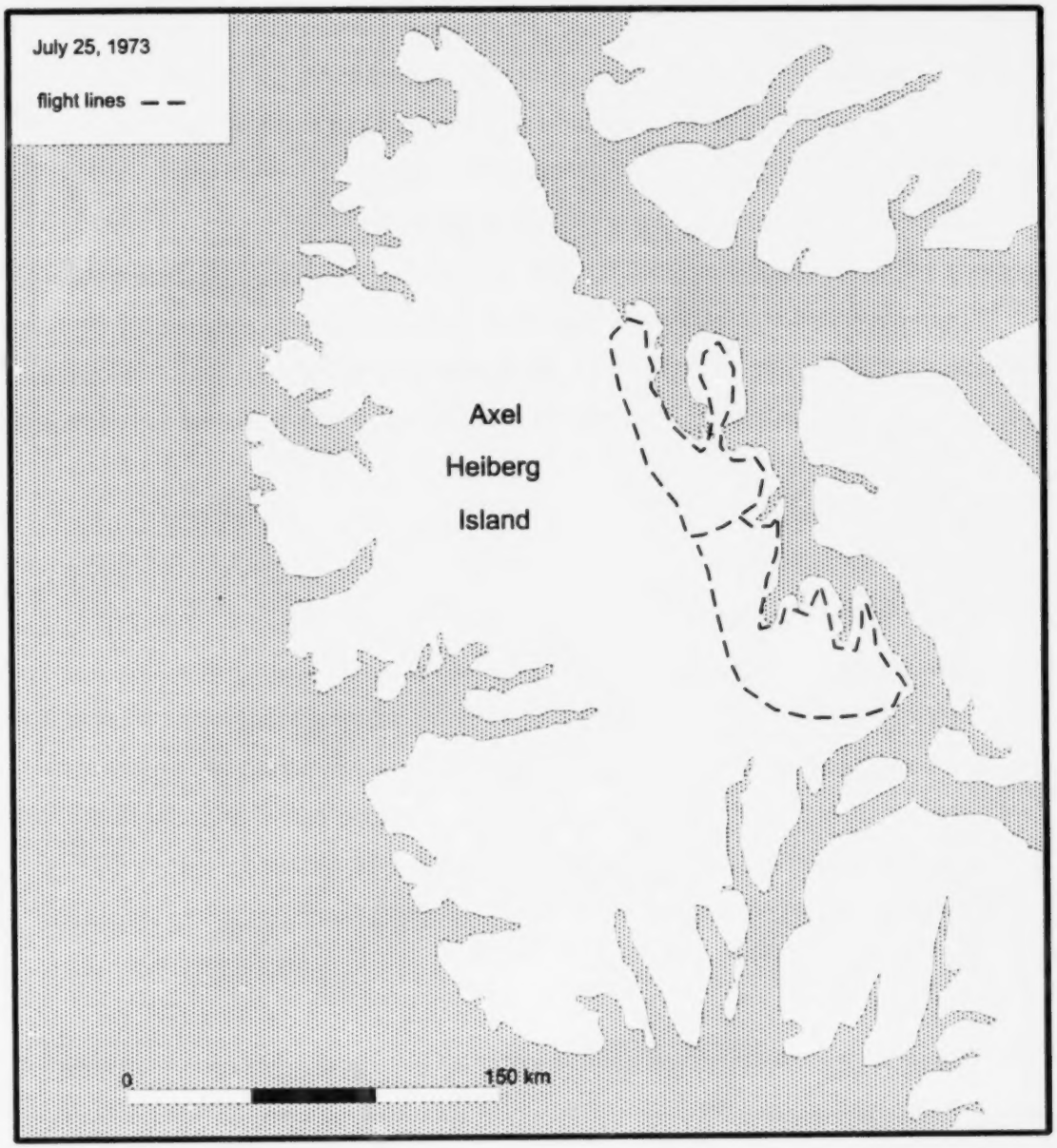

Figure 80. Axel Heiberg Island survey, July 25, 1973, Ross 1973.

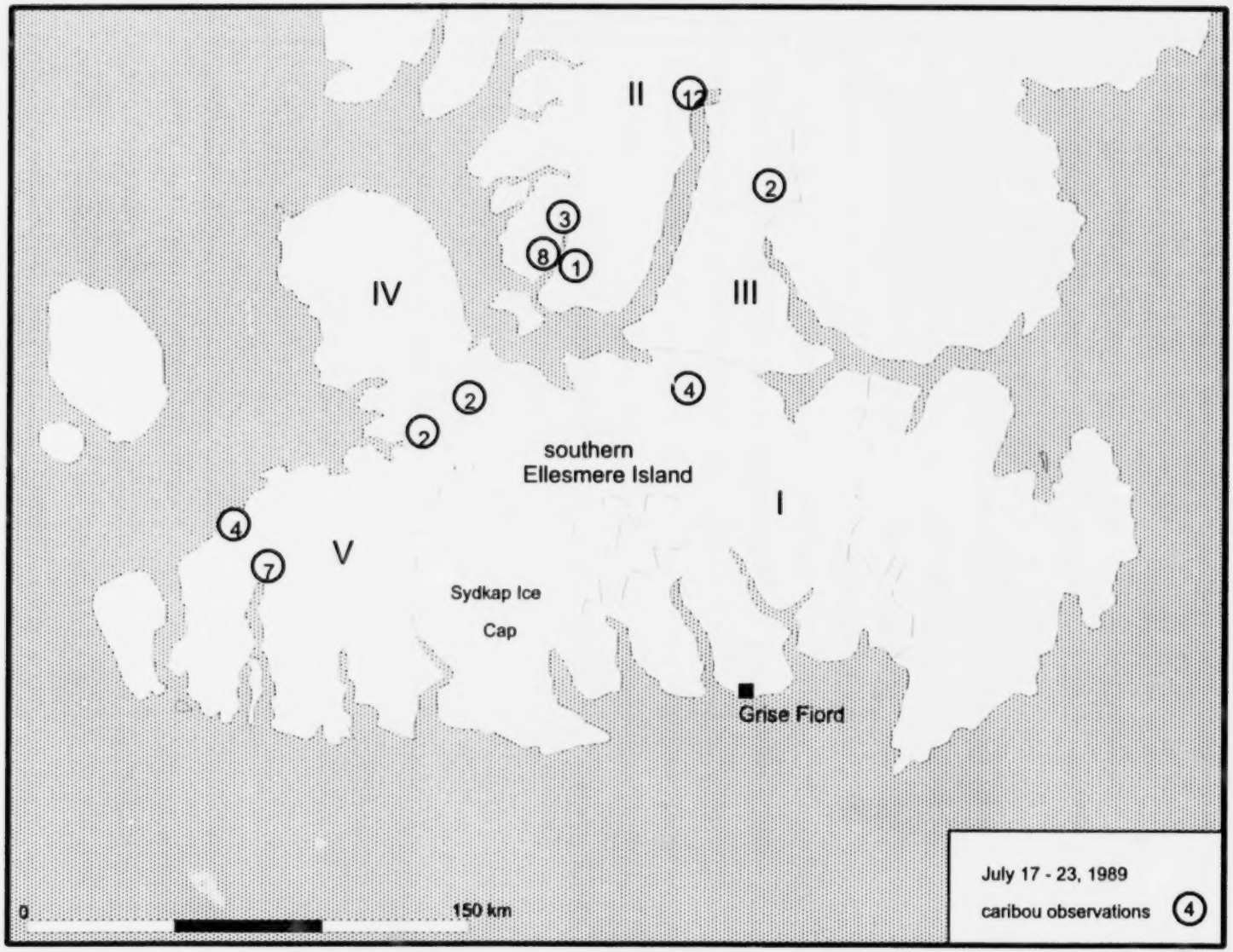

Figure 81. South Ellesmere Island survey area, July 17 - 23, 1989, Case and Ellsworth, 1991.

DISCUSSION

Diversity - calving grounds vary in many of their ecological attributes and thus, are variations in caribou calving strategies likely?

The calving grounds and calving areas for which we compiled information are diverse in their landscapes and habitat. Most calving grounds and calving areas (14 of 20) reach a coast; half of the coasts were low level and half were rugged with elevations exceeding 100 m above sea level. The inland calving grounds and calving areas were rugged hills higher on average than 250 m above sea level.

When calving grounds and calving areas were overlaid on the USGS map of vegetation cover estimated from satellite (NDVA) data, the overlay suggested that the calving grounds were not associated with any particular cover class. Unlike the calving grounds for the major barren-ground herds, shrub and wet tundra were not present on the 20 calving grounds and calving areas, and shrub/brush tundra was only recorded for the Lorillard calving ground (Appendix B). Five calving grounds and calving areas fell into one cover class (sparsely vegetated or herbaceous tundra); seven had two classes and eight had three cover classes.

The amount of plant growth can be indexed by mapping cumulative days with temperatures above 0°C. This index also shows diversity across the calving grounds reflecting the different climatic regions. The annual number of growing degree days varies from <300 in the High Arctic to 400-600 on Victoria Island, and 800-900 on the northeast mainland for the major barren-ground caribou herd calving grounds.

Predator diversity and numbers tend to decrease toward the arctic islands and northeast mainland compared to further south and west. Although we lack the data to quantify those trends, we note them, as caribou behaviour is molded by responses to predation, which likely will influence responses to human activities.

The diversity of landscape, habitat and climate among the calving grounds raises a cautionary note with respect to generalizing between calving grounds. For example, the calving grounds for the Central Arctic herd and the Porcupine herd have taken the stage during the debate over human activities and caribou calving, and a considerable amount of information on calving ecology has accrued (e.g.: Russell *et al.* 1993, Cameron 1994, Cameron *et al.* 1992, Cameron *et al.* 1995, Griffith *et al.* in press). Both the Central Arctic herd and the Porcupine herd's calving grounds are on the western Arctic coast, which is a low-lying plain dominated by cotton-grass and shrub tundra. This raises the question of whether this information can be applied to other calving grounds.

Dogma - how certain are we about the annual return of caribou cows to traditional calving grounds?

Our compilation emphasizes that the confidence with which we describe calving grounds is subject to two sources of uncertainty (after Hilborn and Waltersa 1992, 1993). Firstly, there is true uncertainty - the unknown probability of caribou using a calving ground either because of something that we did not know (a technical or knowledge gap) or ecological constraints (environmental variation). Secondly, there is statistical uncertainty - the unknown probability that the caribou will calve in a particular location. The difference between the two is not absolute - if we learn more about the frequency of use of an area, then the true uncertainty becomes statistical uncertainty.

We emphasize that much of our uncertainty is the consequence of scattered information. For some areas we have no information more recent than the 1970s (Figure 82) and the infrequency of surveys as well as the duration of the period sampled (Figure 83) adds to the uncertainty. Our ability to distinguish between the calving areas (one year with calving observations or calving inferred from post-calving observations) and calving grounds (at least two years of observations of calving overlap) is dependent on sampling frequency and reporting adequacy as well as possible calving strategy differences.

Even when we have a greater frequency of surveys, there are still technical limitations. Within the calving location for a herd, we can list, using the Beverly herd (Gunn and Sutherland 1997) as an example, five technical uncertainties (changes in survey design, changes in timing, weather, adequacy of coverage, and missing data) that contribute observed changes in calving distribution.

Besides technical uncertainties, there are also ecological causes for changes in calving distribution, which include environmentally-caused delays. In 1979, Beverly cows calved over a larger area (approximately 16 000 km^2) than in other years. The large size of the 1979 calving grounds for the Beverly herd probably resulted from a delay in spring migration due to unfavourable weather conditions. Cows were calving when surveyed between 4 and 9 June, although many had not yet reached their known traditional calving grounds (Darby 1980 in Gunn and Sutherland 1997).

Date of last survey
1970s
1980s
1990s

Figure 82. Date of survey information for caribou calving grounds and calving areas.

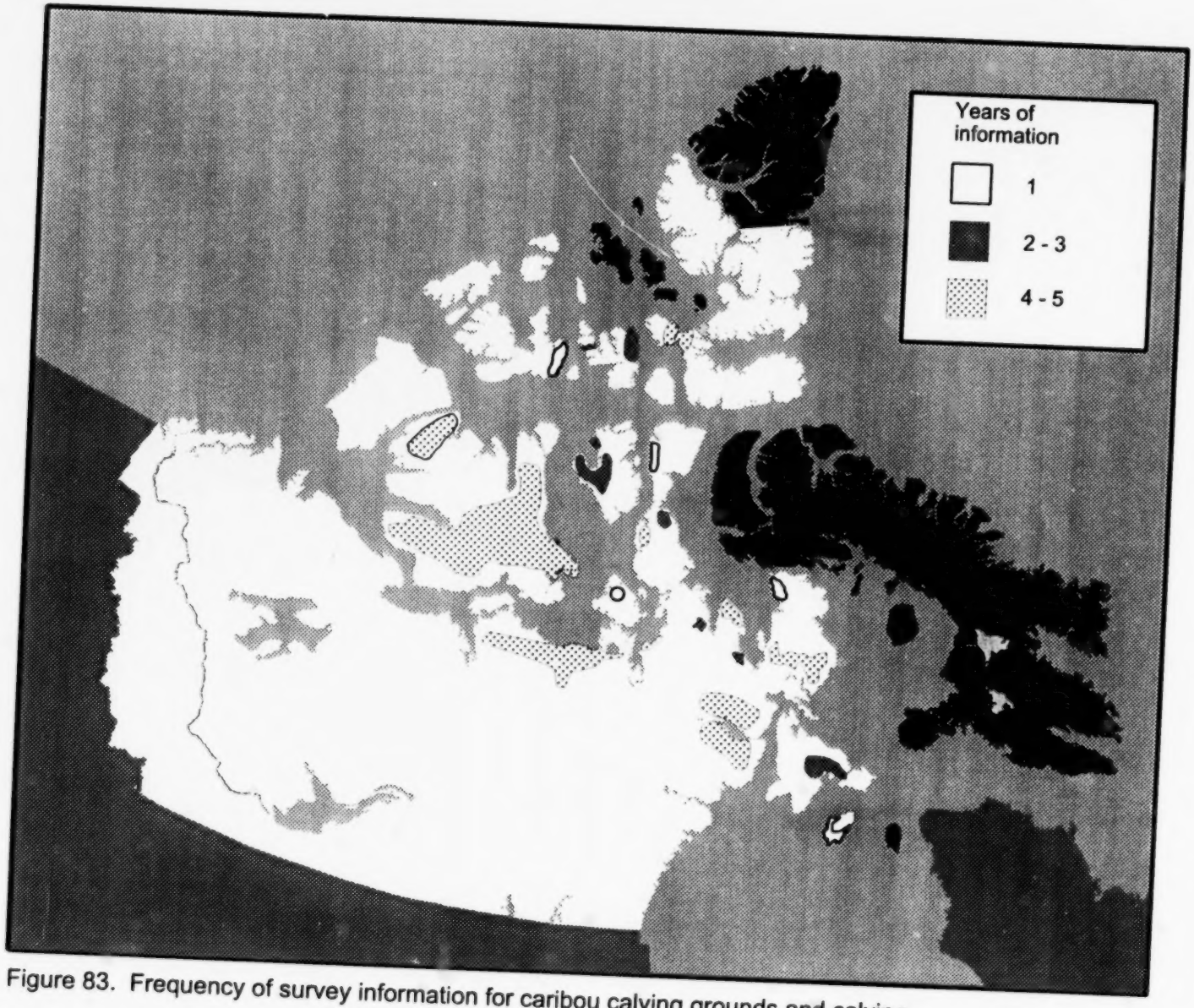

Figure 83. Frequency of survey information for caribou calving grounds and calving

Environmental delays explain part of the variation in annual overlap but there are other reasons for observed changes in calving distribution. Annual fidelity to a calving ground for individual cows is strong although the cows do individually vary. For example, from a sample of 112 cows collared on the NWT's northeast mainland, Heard and Stenhouse (1992) found that 85% of the collared cows returned to within 90 km of the previous year's location. In four instances (3.6%), cows moved between recognized calving grounds. Fancy and Whitten (1991) concluded for the Porcupine herd that while fidelity to the calving grounds was high, individual site fidelity within the calving grounds was low between years.

In the NWT, variation in the annual fidelity of cows to calving sites shows a directional shift in the overlap in annual distribution of calving over the longer term (decadal). For the Bathurst herd, the centre of high density strata moved west about 300 km between 1977 and 1996 which is a return to calving areas used in the 1940s and 1950s. The Beverly herd's centre of high density calving moved about 100 km between 1978 and 1994 which is also a return to calving areas used in the 1940s and 1950s. This raises the possibility that use may be rotational - similar to the decadal rotational use of the winter range (Russell *et al.* 1993) but over a smaller geographic area.

The influence of environmental variation on the location of calving is not restricted to the travelling conditions encountered by the pregnant cows but we know less about how, for example, variations in the timing of plant green-up or the cow's physical condition influence when and where the cows calve. Timing of calving may be later and more variable at the higher latitudes although comparable data are few. Peak calving in the Beverly herd occurred during a 5-day period between 1-17 June for 22 years between 1957 and 1994 (Gunn and Sutherland 1997) compared to 10-20 day peak between 7 June and 7 July on

Bathurst Island (four years of data, F. L. Miller pers. comm.).

Variation in calving dates may be the reason that cows of any one herd use alternate calving grounds. For example, cows that in some years calved on Somerset Island, in other years when calving was later, calved on Prince of Wales Island. The same pattern may hold for other arctic islands such as Prince Patrick and Melville islands where the caribou make inter-island migrations before or after calving.

To summarize, we face technical and ecological uncertainties when we describe the annual return of caribou cows to traditional calving grounds. Those uncertainties have to be built into managing human activities on calving grounds. This has become controversial in northern Canada and Alaska. Like any contentious topic, arguments become polarized and reasoned statements can sound like dogmatic rallying cries. When biologists discuss, for example, caribou cows annually returning to their calving grounds, for emphasis and clarity, we simplify. When we simplify, we may lose the uncertainty and individual variation inherent in biology ('exceptions make the rule'). Counter-arguments focus on the 'exceptions', which can reduce confidence in the adequacy of biological data for informed environmental decisions. Polarized debating over caribou calving grounds is representative of the wider problem with science and scientists of not acknowledging and describing uncertainties in environmental decisions (e.g.: Hilborn and Walters 1992, 1993, Lemons 1996).

Our compilation reveals that our state of knowledge for most herds is considerably more uncertain than for the major barren-ground caribou herds. However, that uncertainty is not an obstacle in resource management and is being increasingly accepted. An example is the 'Precautionary Principle', which

states that "rather than wait for certainty, regulators should act in anticipation of any environmental harm in order to prevent it" (Costanza 1994). Application of the precautionary principle would lead to management actions that would be flexible, reversible, and provide feedback to help reduce uncertainties in knowledge about caribou calving ground use.

PERSONAL COMMUNICATIONS

Akeeagok, S. RWED, Grise Fiord, NWT

Miller, F.L. Canadian Wildlife Service, Edmonton, Alta

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LITERATURE CITED

Bowden, E. and A. Helmer. 1974a. Coats Island caribou survey. Progress Rept. # 2. May 23, 1974. Northwest Territories Wildlife Service unpublished report. 15 pp.

Bowden, E. and A. Helmer. 1974b. Melville Peninsula calving ground survey May-June, 1974. Northwest Territories Wildlife Service unpublished report. 22 pp.

Buckland, L., J. Dragon, A. Gunn, J. Nishi and D. Abernathy. In prep. Distribution and abundance of caribou on the northeast mainland, NWT, 1995. Northwest Territories Department of Renewable Resources Manuscript Report. 25 pp.

Calef and Hellmer. 1981. Population Estimate for the Melville Peninsula Caribou Herd in 1976. Northwest Territories Wildlife Service, INA public. No. QS-8160- 043-EE-AI ESCOM Rep. No. AI-42. 16 pp.

Cameron, R.D. 1994. Distribution and productivity of the Central Arctic caribou herd in relation to petroleum development: Case history studies with a nutritional perspective. Alaska Department of Fish and Game, Division of Wildlife Conservation, Research Final Report, Study 3.35. 35pp.

Cameron, R.D., D.J. Reed, J.R. Dau and W.T. Smith. 1992. Redistribution of calving caribou in response to oil field development on the arctic slope of Alaska. Arctic 45:338-342.

Cameron, R.D., E.A. Lenart, D.J. Reed, K.R. Whitten and W.T. Smith. 1995. Abundance and movements of caribou in the oilfield complex near Prudhoe Bay, Alaska. Rangifer 15(1): 3-7.

Case, R.L. and T. Ellsworth. 1991. Distribution and abundance of muskoxen and Peary caribou on southern Ellesmere Island, NWT, July 1989. Northwest Territories Department of Renewable Resources Manuscript Report No. 41. 23 pp.

Costanza, R. 1994. Three general policies to achieve sustainability. Pages 392-407 *In:* Investing in natural capital - the ecological economics approach to sustainability. Eds A.M. Jansson, M. Hammer, C. Folke and R. Costanza. Island Press, Washington, D.C.

Donaldson, J. 1981. Population and recruitment estimates for the Lorillard and Wager caribou herds in 1977. Northwest Territories Wildlife Service, INA public. No. QS-8160-043-EE-AI ESCOM Rep. No. Ai-43

Elliot and Elliot. 1981. Caribou calving surveys on northern Melville Peninsula and northern Baffin Island, June 1981. Unpubl. Rept. 5 pp

Fancy, S.G. and K.R. Whitten. 1991. Selection of calving sites by Porcupine herd caribou. Can. J. Zool. 69:1736-1743.

Ferguson, M. and D.Vincent. 1992. Status of caribou on northern Melville Peninsula in June 1982. Northwest Territories Department of Renewable Resources, Pond Inlet File Report No. 107. 19 pp.

Fischer, C.A. and E.A. Duncan. 1976. Ecological studies of caribou and muskoxen in the arctic archipelago of northern Keewatin. Renewable Resources Consulting Service Ltd., Edmonton, AB. Prepared for polar Gas Environmental Program. 194 pp.

Fischer, C.A., D.C. Thompson, R.W. Wooley and P.S.Thompson. 1977. Ecological studies of caribou on the Boothia Peninsula and in the District of Keewatin, NWT, 1976. Renewable Resources Consulting Service Ltd., Edmonton, AB. Prepared for polar Gas Environmental Program. 239 pp.

Gates, C.C., J. Adamczewski and R. Mulders. 1986. Population dynamics, winter ecology and social organization of Coats Island Caribou. Arctic 39: 216-222.

Gauthier, L. 1996. Observations of wildlife on Ellesmere and Axel Heiberg islands between June 12-21, 1995. Northwest Territories Department of Renewable Resources Manuscript Report No. 86. 28 pp.

Gunn, A. 1990. The decline and recovery of numbers of caribou and muskoxen on Victoria Island. Pages 590-697 In: Canada's missing dimension: science and history in the Canadian arctic islands. Ed. C.R.Harington. Nat. Mus. Can., Ottawa, ON. 855 pp.

Gunn, A. In prep. The decline of caribou on Northwest Victoria Island: A Review. Northwest Territories Department of Renewable Resources File Report

Gunn, A. and J. Ashevak. 1990. Distribution, abundance and history of caribou and muskoxen north and south of the Boothia Isthmus, NWT, May - June 1985. Northwest Territories Department of Renewable Resources File Report No. 90. 34 pp.

Gunn, A. and R. Decker. 1984. Numbers and distribution of Peary caribou and muskoxen in July 1980 on Prince of Wales, Russell and Somerset islands, NWT. Northwest Territories Department of Renewable Resources File Report No. 38. 56 pp.

Gunn, A. and J. Dragon. In prep. Peary caribou and muskox abundance and distribution on the western Queen Elizabeth Island, NWT, July 1997. Northwest Territories Department of Resources, Wildlife and Economic Development File Report.

Gunn, A. and J. Dragon. In prep. Numbers and distribution of Peary caribou on Prince of Wales, Russell and Somerset Islands, NWT, 21 July - 3 August, 1995. Northwest Territories Department of Resources, Wildlife and Economic Development File Report

Gunn, A., J. Dragon and J. Nishi. 1997. Bathurst calving ground survey, 1996. Northwest Territories Resources, Wildlife and Economic Development File Report No. 119. 70 pp.

Gunn, A. and B. Fournier. In prep. a. Seasonal movements and distribution of caribou on Boothia Peninsula, NWT, 1991-93. Northwest Territories Department of Resources, Wildlife and Economic Development File Report.

Gunn, A. and B. Fournier. In prep. b. Seasonal movements and distribution of satellite-collared caribou on Victoria Island, 1987-88.Northwest Territories Department of Resources, Wildlife and Economic Development File Report.

Gunn, A. and K. Lambert. In prep. Distribution and abundance of caribou and muskoxen on King William Island and Adelaide Peninsula, NWT, June 1986. Northwest Territories Department of Renewable Resources unpublished report.

Gunn, A. and M. Sutherland. 1997. Surveys of the Beverly caribou calving ground, NWT, 1957-1994. Northwest Territories Department of Resources, Wildlife and Economic Development File Report No. 120, 119 pp.

Harington, C.R. 1965. Coats Island caribou survey, 1965. Canadian Wildlife Service Report C 1420. 11 pp.

Heard, D.C. 1985. Caribou census methods used In the Northwest Territories. McGill Subarctic Research Papers No. 40: 229-238.

Heard, D.C. 1992. Distribution and abundance of caribou muskoxen on northwestern Victoria Island. Northwest Territories Department of Renewable Resources Manuscript Report No. 60. 13 pp.

Heard, D.C., G.W. Calef and S. Cooper. 1981. Numbers, distribution and productivity of caribou in Northeastern Keewatin district, N.W.T in 1976. ESCOM Report No. AI-39., DIAND, Ottawa, ON. 27 pp.

Heard, D.C. and R. Decker. 1984. An estimate of the number of caribou on Coats Island, NWT in July 1984. Northwest Territories Wildlife Service unpublished report. 17 pp.

Heard, D.C. and G.B. Stenhouse. 1992. Herd identity and calving ground fidelity of caribou in the Keewatin District of the Northwest Territories. Northwest Territories Department of Renewable Resources File Report No. 101. 34 pp

Heard, D.C., T.M. Williams and K. Jingfors. 1987. Precalving distribution and abundance of barren-ground caribou on the Northeast mainland of the Northwest Territories. Northwest Territories Department of Renewable Resources File Report No. 71. 28 pp.

Hilborn, L., and C. Walters. 1992. Quantitative fisheries stock assessment: choice, dynamics and uncertainty. Chapman and Hall, New York.

Hilborn, L., and C. Walters. 1993. Uncertainty, resource exploitations and conservation: lessons from history. Science 260: 17-36.

Jakimchuk, R.D. and D.R. Carruthers. 1980. Caribou and muskox on Victoria Island, N.W.T. (1980). Prepared for polar gas project , Sidney, BC. 93 pp.

Kiliaan, H.P.L. and D.C. Thomas. 1983. Reconnaissance surveys of caribou and muskoxen in Prince of Wales Strait and on southern Melville Island, June 1982 and 1983. Canadian Wildlife Service. 18 pp.

Lemons, J. ed. 1996. Scientific uncertainty and environmental problem solving. Blackwell Science, Cambridge, Mass. 433pp.

Macpherson, A.H. 1959 Canadian Wildlife Service unpubl. report.

Miller, F.L. 1986. Inter-island movements of Peary caribou across Prince of Wales Strait between Banks and Victoria Islands, Northwest Territories. Canadian Wildlife Service. Prepared for Northern Oil and Gas Action Program, DIAND. 30 pp.

___. 1987. Peary caribou and muskoxen on Bathurst, Alexander, Marc, Massey, Vanier, Cameron, Helena, Lougheed, and Edmund Walker islands, Northwest Territories, July 1985. Tech. Rep. Ser. No. 20. Can. Wildl. Serv., West. & North. Reg., Edmonton, Alta. 45 pp.

___. 1988. Peary caribou and muskoxen on Melville and Byam Martin islands, Northwest Territories, July 1987. Tech. Rep. Ser. No. 37. Can. Wildl. Serv., West. & North. Reg., Edmonton, Alta. 58 pp.

___. 1989. Reevaluation of the status of Peary caribou and muskox populations within the Bathurst Island complex, Northwest Territories, July 1988. Tech. Rep. Ser. No. 78. Can. Wildl. Serv., West. & North. Reg., Edmonton, Alta. 86 pp.

Miller, F.L.1991. Peary caribou calving and postcalving periods, Bathurst Island complex, Northwest Territories, 1989. Tech. Rep. Ser. No. 118. Can. Wildl. Serv., West. & North. Reg., Edmonton, Alta. 72 pp.

___. 1992. Peary caribou calving and postcalving periods, Bathurst Island complex, Northwest Territories, Canada, 1990. Tech. Rep. Ser. No. 151. Can. Wildl. Serv., West. & North. Reg., Edmonton, Alta. 87 pp.

___. 1993. Peary caribou calving and postcalving periods, Bathurst Island complex, Northwest Territories, Canada, 1991. Tech. Rep. Ser. No. 166. Can. Wildl. Serv., West. & North. Reg., Edmonton, Alta. 99 pp.

___. 1994. Peary caribou calving and postcalving periods, Bathurst Island complex, Northwest Territories, 1992. Tech. Rep. Ser. No. 186. Can. Wildl. Serv., Prairie & North. Reg., Edmonton, Alta. 99 pp.

Miller, F.L., E.J. Edmonds and A. Gunn. 1982. Foraging behaviour of Peary caribou in response to springtime snow and ice conditions. Canadian Wildlife Service Occasional Paper No. 48. 41 pp.

Miller, F.L. and A. Gunn. 1979. Responses of Peary caribou and muskoxen to helicopter harassment. Canadian Wildlife Service Occasional Paper No. 40. 90 pp.

Miller, F.L. and R.H. Russell. 1975. Aerial surveys of Peary caribou and muskox on Bathurst Island, Northwest Territories, 1973 and 1974. Can. Wildl. Serv. Prog. Note. No. 44. 8 pp.

Miller, F.L., R.H. Russell, and A. Gunn. 1977a. Distributions, movements and numbers of Peary caribou and muskoxen on western Queen Elizabeth Islands. Canadian Wildlife Service Report Series No. 40. 55 pp.

Miller, F.L., R.H. Russell, and A. Gunn. 1977b. Inter-island movements of Peary caribou (Rangifer tarandus pearyi) on western Queen Elizabeth Islands, Arctic Canada. Can. J. Zool. 55:1029-1037.

Mulders, R. In prep. a. Aerial survey of Southampton Island, July, 1995. Northwest Territories Resources, Wildlife and Economic Development File Report.

Mulders, R. In prep. b. Aerial survey of Southampton Island, June, 1997. Northwest Territories Resources, Wildlife and Economic Development File Report.

Nishi, J. In prep. Distribution of radio-collared caribou on Victoria Island, NWT (April 1994 - June 1996). Northwest Territories Resources, Wildlife and Economic Development File Report.

Ouellet, J-P. 1992. Ecology of an introduced caribou population on Southampton island, N.W.T., Canada. Ph.D.Thesis, Dept. of Zoology, University of Alberta, Edmonton, AB. 123 pp.

Pendergast, B. and E. Bowden. 1973. Melville Peninsula calving ground survey May-June, 1973. Northwest Territories Wildlife Service unpublished report. 7 pp.

Rippen, B. and E. Bowden. 1972a. Coats Island caribou survey, May 1972. Northwest Territories Wildlife Service unpublished report. 8 pp.

Rippen, B. and E. Bowden. 1972b. Melville Peninsula caribou study May 20 to 22, 1972. Northwest Territories Wildlife Service unpublished report. 7 pp.

Ross, R.K. 1973. Aerial survey of muskoxen (*Ovibus moshatus*) on eastern Axel Heiberg Island, summer 1973. Canadian Wildlife Service, Ontario Regional Headquarters, Ottawa, ON. 6 pp.

Russell, D.R., A.M. Martell and W. Nixon. 1993. Range ecology of the Porcupine Caribou Herd in Canada. Rangifer Special Issue 8.

Sutherland, M. and A. Gunn. 1996. Bathurst calving ground surveys, 1965 - 1996. Northwest Territories Department of Resources, Wildlife and Economic Development File Report No. 118. 97 pp.

Tener, J.S. 1963. Queen Elizabeth Islands game survey, 1961. Canadian Wildlife Service Occasional Paper No. 4. 50 pp.

Thomas, D.C. 1969. Population estimates and distribution of barren-ground caribou in Mackenzie District, N.W.T., Saskatchewan, and Alberta - March to May, 1967. Can. Wildl. Serv. Rept. Ser. No. 9. Ottawa. 44 pp.

Thompson, D.C. and C.A. Fischer. 1980. Numbers and distribution of caribou on the Boothia Peninsula, Northwest Territories. Canadian Field-Naturalist 94(2):171-174.

APPENDIX A. Summary of survey dates and types and other observations used to identify and substantiate calving grounds and calving areas.

	Survey dates					
	Pre-calving	**Calving**	**Post-calving**	**1st date calf seen**	**Type of survey**	**Other observations**
1. Queen Maud Gulf						
1975	May	--	--	--	systematic	--
1976	--	4 - 15 Jun	--	unknown	systematic	--
1983	4 - 11 May	--	--	--	systematic	--
1986	--	11 - 12 Jun	--	5 Jun	systematic	ferry flight (5 Jun)
1995	24 - 26 May	--	--	--	systematic	--
1996	--	7, 12 - 13 Jun	--	7 Jun	systematic	satellite collars
1997	--	--	--	--	--	satellite collars
2. Arrowsmith Bay						
1975	--	31 May - 5 Jun	--	unknown	systematic	--
1976	--	--	1 - 4 Jul	--	systematic	--
1983	4 - 11 May	--	--	--	systematic	--

1985	--	7 - 9 Jun	--	7 Jun	systematic	--
1986	--	8 - 9 Jun	--	9 Jun	systematic	--
1989	--	--	--	9 Jun	--	ferry flight (12 Jun)
1991	--	--	--	12 Jun	--	ferry flight (12 Jun)
1995	19 - 23 May		--	--	systematic	--
3. King William Island						
1986	--	10 - 11 Jun	--	10 Jun	systematic	--
4. Boothia Peninsula - east						
1974	--	Jun	--	--	systematic	--
1975	--	Jun	--	--	systematic	--
1985	--	31 May - 13 Jun	--	--	systematic	--
1991	--	--	--	--	--	satellite collars
1992	--	--	--	--	--	satellite collars
1993	--	--	--	--	--	satellite collars

5. Simpson Lake						
1983	4 – 11 May	--	--	--	systematic	--
1985	--	7 – 9 Jun	--	--	systematic	--
1989	--	9 – 12 Jun	--	--	systematic	--
1995	19 – 23 May	--	--	--	systematic	--
6. Keith Bay						
1983	4 – 11 May	--	--	--	systematic	--
1991	--	--	--	--	--	satellite collars
1992	--	--	--	--	--	satellite collars
1995	19 – 23 May	--	--	--	systematic	--
7. Simpson Peninsula						
1983	4 – 11 May		--	--	systematic	--
1989	--	10 Jun	--	10 Jun	systematic	--
1991	--	14 Jun	--	14 Jun	un-systematic	satellite collars
1992	--	19 Jun	--	19 Jun	un-systematic	satellite collars

1993	--	8 Jun	--	8 Jun	un-systematic	satellite collars
1995	19 – 23 May	--	--	--	systematic	--
8. Wager Bay						
1974	--	2 – 5 Jun	--	2 Jun	recon-naissance	--
1976	--	--	29 Jun-2 Jul	--	systematic	--
1977	--	12 – 15 Jun 16 – 21 Jun	--	12 Jun	recon-naissance stratified	--
1983	4 – 11 May	--	--	--	systematic	--
1985 – 88	--	--	--	--	--	radio collars
1995	19-23 May	--	--	--	systematic	--
9. Lorillard herd						
1976	--	15 – 25 Jun	--	15 Jun	systematic	--

1977	--	4-5,10-12 Jun 14 – 15 Jun	--	5 Jun	recon-naissance stratified	--
1983	4 – 11 May	--	--	--	systematic	--
1985 – 88	--	--	--	--	--	radio collars
1995	19-23 May	--	--	--	systematic	--

10. Southern Melville Peninsula

1972	20-22 May	--	--	--	un-systematic	--
1974	--	2 – 5 Jun	--	2 Jun	un-systematic	--
1976	--	--	19-21 Jun	--	systematic	--
1983	4 – 11 May	--	--	--	systematic	--
1985 – 88	--	--	--	--	--	radio collars
1991	--	--	--	--	--	satellite collar
1995	19-23 May	--	--	--	systematic	--

11. Northern Melville Peninsula						
1983	4 – 11 May	--	--	--	systematic	--
1982	--	6 – 15 Jun	--	unknown	systematic	--
1995	19 – 23 May	--	--	--	systematic	--
12. Southampton Island						
1983	--	--	25 Jun-12 Jul	--	un-systematic	--
1987	--	--	Jun	--	random blocks	--
1991	--	--	Jun	--	random blocks	--
1995	--	--	1-3, 8 – 17 Jul	--	systematic	--
1997	--	16 – 26 Jun	--	--	random blocks	--
13. Coats Island						
1972	May	--	--	--	systematic	--
1974	23 May	--	--	--	systematic	--
1975	--	--	28 – 29 Jun	--	systematic	--

1980	--	--	28 – 29 Jun	--	systematic	--
1984	--	--	Jun	--	systematic	--

14. Northwest Victoria Island

1980	--	--	July, August	--	systematic	--
1982	--	7-9 June	--	--	un-systematic	--
1983	--	4 - 6 Jun	--	--	un-systematic	--
1985	--	4 - 13 Jun	--	--	un-systematic	--
1987	--	21 Jun	--	5 Jun	systematic	satellite collars
1988	--	18 Jun	--	--	systematic	satellite collars
1993	--	13-15 Jun	--	13 Jun	systematic	--
1994	--	5 - 16 Jun	--	--	systematic	--

15. Victoria Island - Dolphin and Union Strait

1980	--	--	July, August	--	systematic	--

1987	--	21 Jun	--	5 Jun	systematic	satellite collars
1988	--	12 - 18 Jun	--	--	systematic	satellite collars
1994	--	15 - 16 Jun 17 - 18 Jun	--	--	systematic un-systematic	radio collars
1995	--	8 - 9 Jun	--	--	un-systematic	radio collars
1996	--	14 - 16 Jun	--	--	un-systematic	radio collars
1997	--	10 - 18 Jun	--	--	un-systematic	radio collars
16. Prince of Wales, Russell and Somerset islands						
1974	--	3 - 14 Jun	27 Jul - 1 Aug	--	systematic	--
1975	--	15 - 24 Jun	--	--	systematic	--
1977	--	12 - 18 Jun	--	--	un-systematic	--
1978	--	late Jun	--	--	un-systematic	--
1980	--	Jun	12 - 22 Jul	--	un-systematic	--

1995	--	--	21 Jul - 3 Aug	--	systematic	--
17. Boothia Peninsula - west						
1974	--	7 - 20 Jun	--	7 Jun	systematic	--
1975	--	5 - 12 Jun	28 Jun - 2 Jul	unknown	systematic	--
1985	--	31 May - 13 Jun	--	3 June	systematic	--
1991	--	13 Jun	--	13 June	un-systematic	satellite collars
1992	--	15 Jun	--	--	Un-systematic	satellite collars
18. Prince Patrick and Melville islands						
1961	--	--	Jun - Aug	--	systematic	--
1972	--	--	Jul - Aug	--	systematic	--
1973	--	--	Jul - Aug	--	systematic	--
1974	13-14 May	8 - 29 Jun	Jul - Aug	--	systematic un-systematic	--

1975	--	--	1 Jul	--	systematic	--
1977	--	--	11 - 13 Jul	--	systematic	--
1982	--	7 - 9 Jun	--	--	un-systematic	--
1983	--	4 - 6 Jun	--	--	un-systematic	--
1987	--	--	1 - 22 Jul	--	systematic	--
1997	--	--	29 Jun -24 Jul	--	systematic	--
19. Bathurst Island						
1961	--	--	19, 27-28 Jun 1, 3, 7 Jul		systematic	--
1974	--	--	18 - 25 Aug		systematic	--
1975	--	--	25 - 26 Jun		systematic	--
1977	--	--	11 - 13 Jul		systematic	--
1987	--	--	1 - 22 Jul		systematic	--
1988	--	--	11 - 21 Jul		systematic	--
1990	--	1 Jun - 10 Jul	--		un-systematic	--

1991	--	7 Jun - 7 Jul	--		un-systematic	--
1992	--	Jun, 5 - 8 Jul	--		un-systematic	--
1993	16-24 Aug	--	--		un-systematic	--
1997	--	--	Jul		systematic	--
1998	--	--	20 - 30 Jul		--	--
20. Ellesmere and Axel Heiberg islands						
1961	--	--	Jul-Aug	--	systematic	--
1973	--	--	25 Jul	--	un-systematic	--
1989	--	--	17-23 Jul	--	un-systematic	--
1995	--	12-21 Jun	--		un-systematic	--

APPENDIX B. SUMMARY OF VEGETATION AND TOPOGRAPHY FOR CARIBOU CALVING GROUNDS IN THE NWT AND NUNAVUT.

calving ground	coastal/ inland	topography	elevation	shrub	wet tundra	herbaceous Tundra	bare ground tundra	mixed tundra	shrub and brush	sparsely vegetated
Bluenose	coastal	lowlands	50 m	x	x	x	x		x	
Bathurst	inland	varied, increased elevation	50-250 m		x	x			x	
Beverly	inland	varied outcrops, glacial landforms	200 m			x			x	
Qaminirjuaq	inland	varied	100 m		x	x			x	
Wager	inland	highlands and hills, rocky plains	300-400 m							
Lorillard	inland	highlands and hills, rocky	250-500 m			x			x	

calving ground	coastal/ inland	topography	elevation	shrub	wet tundra	herbaceous Tundra	bare ground tundra	mixed tundra	shrub and brush	sparsely vegetated
		plains								
S. Melville Peninsula	inland	plateau, highlands	300 m			x	x			x
N. Melville Peninsula	coastal	hilly, highlands	300 m			x	x			
Keith Bay	coastal	lowlands	50-100 m			x	x			
Simpson Peninsula	coastal	lowlands	50-100 m			x	x			x
Arrowsmith Lowlands	coastal	lowlands	50-100 m			x				
E. Boothia Peninsula	inland	hilly, rugged	300 m			x	x			x
Queen Maud Gulf	coastal	uplands, extensive marine silt plains	150 m			x				
Southampton Island	coastal	rugged	300-500 m			x	x			x

calving ground	coastal/ inland	topography	elevation	shrub	wet tundra	herbaceous Tundra	bare ground tundra	mixed tundra	shrub and brush	sparsely vegetated
Coats Island	coastal	lowlands	50 m			x	x			x
arctic-island caribou										
W. Boothia Peninsula	inland	hilly, rugged	300 m			x	x			x
Prince of Wales	coastal	varied, broad drainage, rolling terrain	50-100 m							x
Dolphin and Union	coastal	lowlands	50-100 m			x	x			x
NW Victoria Island	coastal	hilly	300 m			x	x			x
Banks Island (2)	coastal/ inland	hilly contour	300 m			x	x			
Peary Caribou										
Bathurst Island	coastal	lowlands	50-100 m				x			x

calving ground	coastal/ inland	topography	elevation	shrub	wet tundra	herbaceous Tundra	bare ground tundra	mixed tundra	shrub and brush	sparsely vegetated
Melville Island	coastal	hilly	300 m				x			x
Devon Island	coastal	rugged	300 m							x
Axel Hieburg Island	coastal	rugged	300 m				x			x
Arrowsmith Lake	coastal	hilly	>100 m			x	x			